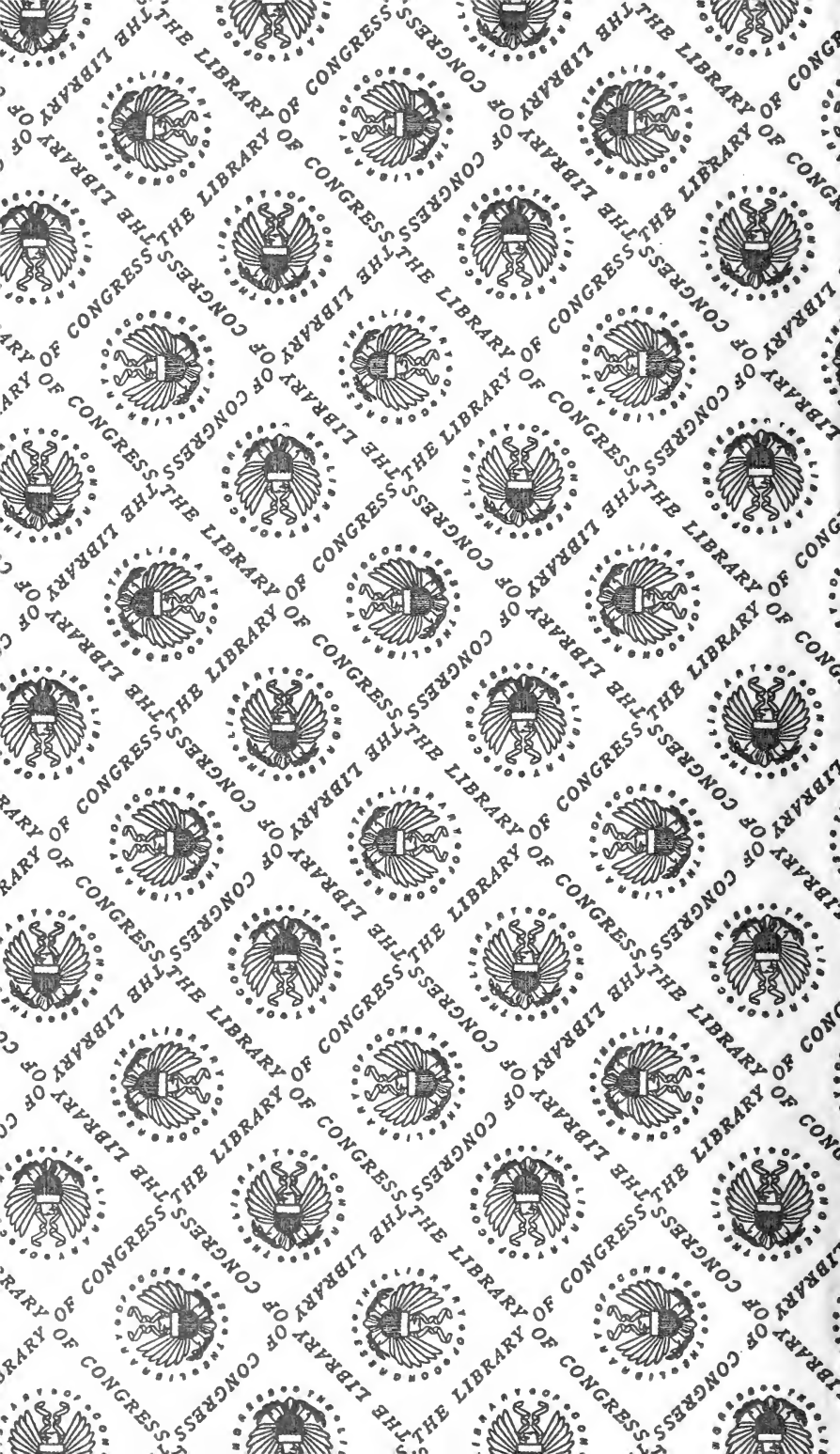
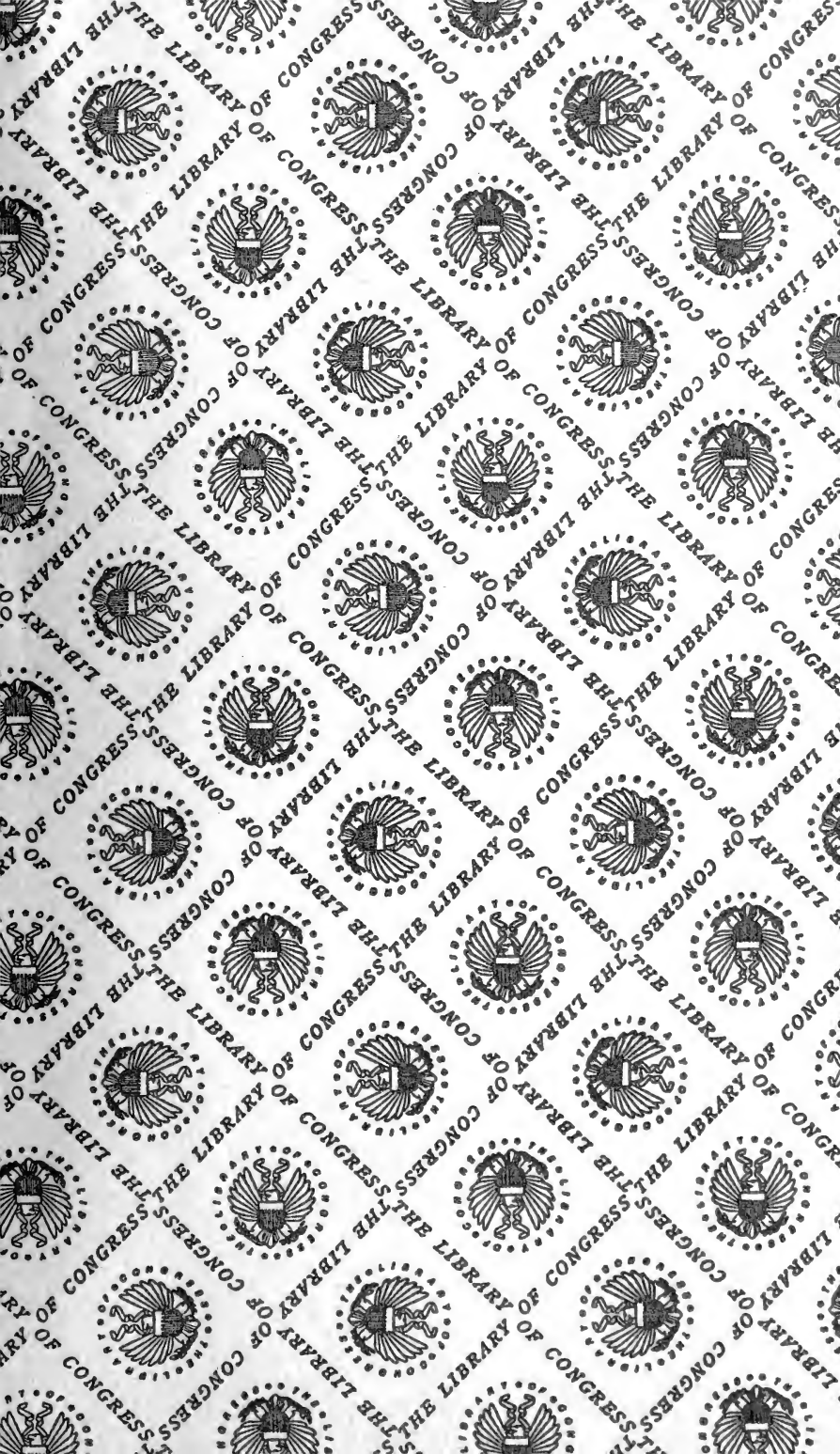


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OF

THE PUBLIC SERVICE COMMISSION

OF THE

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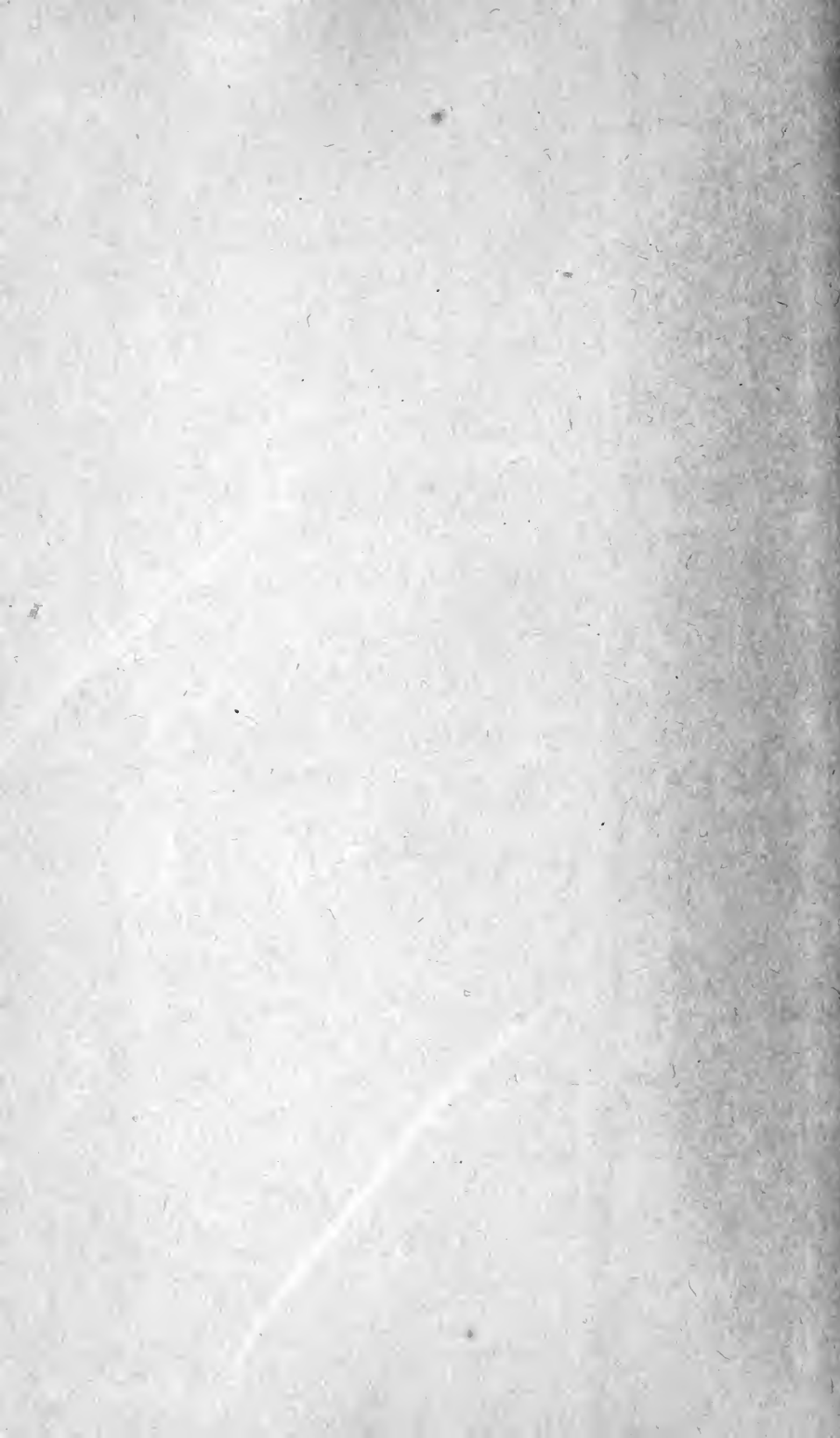
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FIRST ANNUAL REPORT

For the Year Ending June 30th, 1914.

F. HERBERT SNOW, C. E., Chief.

HARRISBURG, PA.:
WM. STANLEY RAY, STATE PRINTER
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ARRANGEMENT

LETTER OF TRANSMITTAL.

PART I. INTRODUCTION.

PART II. ORGANIZATION AND ADMINISTRATION.

PART III. RULES AND REGULATIONS PERTAINING TO ELECTRIC,
GAS, HEATING AND WATER SERVICE UTILITIES.

PART IV. IMPROVEMENT OF THE PORT OF PHILADELPHIA.



LETTER OF TRANSMITTAL

Harrisburg, Pa., June 30th, 1914.

To the Public Service Commission of the Commonwealth of Pennsylvania—Mr. Archibald B. Millar, *Secretary*.

Dear Sir:—I have the honor to submit the First Annual Report of the Bureau of Engineering.

I assumed the duties of the office of Chief of the Bureau on April 1st, 1914, the date when the Bureau was also created.

To meet a demand which is quite general among engineers for an explanation of the application and scope of the Public Service Company Law to matters appertaining to engineering, and as a partial explanation for the operations of the Bureau (limited by the Commission's directions), I have conveniently arranged the law respecting this phase of it. Any member of the profession desiring to get a comprehensive conception of the law from the engineer's standpoint, may, by reference to this digest, find the help he desires. This comprises the Introduction, or Part I of my report.

Since the fiscal year for which this report is made covers the three months' period of Bureau activities between April 1st and June 30th, it seems fitting that I should at this time make a report including not only the activities of the Bureau for the said first three months of its existence, but also containing some observations upon activities of the Commission and its agents relative to the Bureau work prior and leading up to its creation, and some observations regarding future work for which preparation is being made.

Part II of my report deals with the organization of the Bureau staff and the work accomplished by the Bureau up to June 30, 1914.

Part III deals with rules and regulations pertaining to electric, gas, heating and water service utilities and is explanatory of what has been done and what it is purposed to do in administering the orders of the Commission, framed under the law.

Certain matters relative to the development of the Port of Philadelphia have received the attention of the Commission. In this connection, the Bureau has investigated at length and made a report on the relocation and elevation of the railroads and terminal yards

and facilities in South Philadelphia. The project as approved in a general way by the Commission requires an expenditure of \$25,000,000 within the next five years, and this is a part only of the comprehensive plan for the Port improvement.

Since the regulation of express, ferry, baggage transfer, railroads, street railway and all common carriers, telephone, telegraph, wharf, refrigerator and grain elevator companies, including individuals, partnership or associations and companies engaged for profit in such business, is imposed by law on the Commission, which law defines the duties and limits the power of such companies, I have thought it pertinent at this time to set forth in some detail, and in this connection, a description of the Port of Philadelphia and the facilities which have and are likely to receive the attention of the Commission, and which have already entered into the plans studied by the Bureau. This comprises Part IV of my report.

All of which is respectfully submitted.

F. HERBERT SNOW,
Chief, Bureau of Engineering.

PART ONE

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PART ONE

INTRODUCTION—COMMENTS ON THE PUBLIC SERVICE COMPANY LAW.

As an aid to a better understanding of the scope of the work to be performed by the Bureau of Engineering of the Public Service Commission, attention is called briefly to the said Public Service Company Law, which defines Public Service Companies and provides for their regulation by prescribing their duties and liabilities, limiting their powers, regulating their incorporation and by creating and establishing a Public Service Commission for the regulation aforesaid.

I.—SOME CORPORATE DEFINITIONS—PERTINENT TO ENGINEERING.

PUBLIC SERVICE COMPANIES include the following corporations and also all persons (meaning all individuals, partnerships or associations, other than corporations), engaged for profit in the same kind of business, within Pennsylvania.

PUBLIC SERVICE CORPORATION ARRANGED ALPHABETICALLY.

1. Artificial Gas.	10. Grain Elevator.	19. Stage Line.
2. Baggage Transfer.	11. Heat.	20. Street Railway.
3. Bridge.	12. Incline Plane.	21. Telegraph.
4. Canal.	13. Natural Gas.	22. Telephone.
5. Common Carriers.	14. Pipe Line.	23. Tunnel.
6. Dining Car.	15. Pullman Car.	24. Turnpike.
7. Electric.	16. Railroad.	25. Water.
8. Express.	17. Refrigerator.	26. Water Power.
9. Ferry.	18. Sewage.	27. Wharf.

a—The term "SERVICE" means and includes any and all acts done, rendered or performed, and any and all things furnished or supplied by public service companies in the performance of their duties to their patrons, employees, and the public, as well as the interchange of facilities between two or more public service companies.

b—The term “FACILITIES” means and includes all plant and equipment of a public service company, and any and all means and instrumentalities in any manner owned, operated, leased, licensed, used, controlled, furnished, or supplied for, by, or in connection with the business of any public service company, which includes all tangible real and personal property, all

1. Buildings.	5. Rights of Trackage.	9. Street Railways.
2. Materials.	6. Subways.	10. Tracks.
3. Casements.	7. Tunnells.	11. Canals.
4. Rights of Way.	8. Railroads.	

AND ALL

1. Animals.	27. Barges.	53. Holders.
2. Locomotives.	28. Cables.	54. Retorts.
3. Apparatus.	29. Conduits.	55. Ducts.
4. Appliances.	30. Converters.	56. Pipes.
5. Devices.	31. Transformers.	57. Pipe galleries.
6. Instruments.	32. Condensers.	58. Pipe lines.
7. Appurtenances.	33. Wires.	59. Mains.
8. Freights cars.	34. Poles.	60. Meters.
9. Refrigerator cars.	35. Structures.	61. Lamps.
10. Baggage cars.	36. Telegraph lines.	62. Scrubers.
11. Express cars.	37. Telephone lines.	63. Wharves.
12. Passenger cars.	38. Crossbars.	64. Piers.
13. Drawing-room cars.	39. Engines.	65. Docks.
14. Parlor cars.	40. Machines.	66. Ferries.
15. Sleeping cars.	41. Dynamos,	67. Incline planes
16. Dining cars.	42. Boilers.	68. Side tracks.
17. Rolling stock.	43. Motors.	69. Spurs.
18. Carriages.	44. Storage batteries.	70. Turn outs.
19. Cabs.	45. Switchboards.	71. Switches.
20. Hansoms.	46. Water-falls.	72. Systems.
21. Taxicabs.	47. Water-power stations.	73. Stations.
22. Vehicles.	48. Power stations.	74. Depots.
23. Boats.	49. Pumping stations.	75. Terminals.
24. Ships.	50. Reservoirs.	76. Terminal facilities.
25. Vessels.	51. Purifiers.	77. Water or gas jet.
26. Bridges.	52. Oil Tanks.	78. Wells.

II.—SOME CORPORATE DUTIES AND LIABILITIES—PERTINENT TO ENGINEERING.

a—*Service.*—It is the duty of every public service company—

“To furnish and maintain such service, including facilities as shall in all respects be just, reasonably adequate and practically sufficient for the accommodation and safety of its patrons, employees and the public, and in conformity with such reasonable regulations or orders as may be made by the Commission.”

b—*Repairs, Extensions, Etc.*—It is the duty of every public service company—

“To make all such repairs, changes, alterations and improvements in or to such service, including facilities, as shall be reasonably necessary for the accommodation or safety of its patrons, employees and the public.”

c—*Contracts.*—It is the duty of every public service company—

“To file with the Commission, when required by it, verified copies of any and all contracts, writings, agreements, leases, arrangements, or other engagements entered into by such public service company with any person, corporation, municipal corporation, any State government, the Federal government, or any branch or sub-division thereof, or other public service company, in relation to its public service.”

d—*Reports.*—It is the duty of every public service company—

“To make and file, when and in the manner and form required by the Commission, any and all reports to the Commission, which shall contain such facts, accounts and information as may be prescribed by the Commission; and, generally, to furnish any and all information required by the Commission in the performance of its duties under this act.”

e—*Maps, Profiles, Reports, Records, Etc.*—Also

“To furnish to the Commission, from time to time, and as the Commission may require, all maps, profiles, reports of engineers, books, papers, records and other documents or memoranda, or copies of any or all of them, in aid of any inspection, examination, inquiry, investigation, or hearing, or in aid of any determination of the value of its property, or any portion thereof; and to co-operate with the Commission in the work of the valuation of its property, or any portion thereof; and to furnish any and all other information to the Commission as the Commissioner may require, in any inspection, examination, inquiry, investigation, hearing, or determination of such valuation of its property and facilities.”

f—*Service and Facilities of Common Carriers.*—It is the duty of every public service company—

“If a railroad corporation or street railway corporation, or other common carrier, to furnish a reasonably sufficient number of safe trains, cars, vehicles, boats, or other facilities; and to run and operate the same with such motive power as may reasonably be required, in the conveyance of all such passengers or property as may seek, or be offered to it, for such conveyance; and to run and operate its said trains, cars, vehicles, boats, or other facilities with sufficient frequency at such reasonable and proper times, and to and from such stations or points, as the Commission, having regard to the general convenience and safety of the public, may require; and, when reasonably required by the Commission, to change the time schedule for the running and operation of its trains, cars, vehicles, boats, or other facilities; and, generally, make any other arrangement and improvements in its service which the Commission may lawfully and reasonably determine and require.”

g—*Switch Connections.*—Also it is the duty of every public service company—

“If a railroad corporation, upon application of any owner or operator of any lateral railroad, or any private side track, or of any shipper, tendering property or traffic for transportation, or of any consignee, to construct, maintain, and operate, at a reasonable place and upon

reasonable terms, a switch connection with any such lateral railroad or private side track which may be constructed to connect with its railroad, where such connection may be reasonably practicable and can be put in with safety, and will furnish sufficient business to justify the construction and maintenance of the same: Provided, That whenever any lateral line of railroad or private side-track has been so connected with a line of any railroad, or whenever any owner of such lateral railroad or any private side track has at any time heretofore sold, or leased, or shall hereafter sell or lease, such lateral railroad or side track to any railroad corporation, any person or corporation shall be entitled to connect thereunto, or to use the same, upon payment to the party incurring the primary expense thereof of a reasonable proportion of the cost of the said lateral railroad or private side track, and of the maintenance thereof, which shall be determined, in case of disagreement among the parties, by the Commission, after notice to the interested parties, and a hearing. Provided, That such connection and use can be made without unreasonable interference with the use thereof by the party incurring the primary expense or owning or leasing said lateral railroad or side track."

h—Continuous Transportation, Etc.—It is the duty of every public service company—

"If a telephone or telegraph corporation, or person or persons engaged in like business, to cause the transmission of dispatches, messages, or communications by it to be reasonably continuous, and without unreasonable interruption or delay; and, if a common carrier, to cause the conveyance of passengers and property by it to be reasonably continuous, and without unreasonable interruptions or delay."

i—Through Routes.—It is the duty of every public service company—

"If a railroad corporation or a street railway corporation, to construct and maintain whenever the Commission may require, the same, such switch or other connections with or between the lines of other companies of the same character, where the same is reasonably practical and can be connected, to form a continuous line of transportation, and to cause the companies of persons and property between points within this Commonwealth to be without unreasonable interruption or delay; and to establish through routes and service therein, and just and reasonable joint rates, fares and charges applicable thereto; and, where practicable, transport freight over the same without transfer from the originating cars; and shall not discriminate in the said rates, fares, charges, or in any rates or regulations applicable thereto, between any such connecting lines: Provided, That no railroad corporation or street railway corporation shall be required to give the use of its tracks or terminal facilities to any other common carrier: AND PROVIDED, That this section shall not apply to a street railway corporation engaged in the business of carrying passengers, but not engaged in the general business of transporting freight, and which does not generally solicit the transportation of freight, as a main branch of its business."

j—*Grade Crossings, Etc.*—It is the duty of every public service company—

“To obey and abide by all lawful orders and regulations of the Commission, made under the provisions of this act, regulating the manner in which the tracks or other facilities of any railroad corporation, street railway corporation, or any other public service company, may be constructed across the tracks or other facilities of any other railroad corporation, street railway corporation, or any other public service company, at grade, or above or below grade, or at any prescribed level; or in which the tracks or other facilities of any railroad corporation or street railway corporation may be constructed across any public highway at grade; or above or below grade; or in which any public highway may be constructed across the tracks or other facilities of any railroad corporation or street railway corporation at grade, or above or below grade; or regulating the manner in which such crossings shall be operated, maintained, and protected, including the stationing of watchmen thereat, installation and regulation of lights, blocks or other system of signalling, safety appliances, devices, or such other means or instrumentalities as the Commission may prescribe; as well as to obey and abide by all lawful orders and regulations of the Commission made under the provisions of this act, requiring the lateration, removal, or abolition of any such crossing,—to the end, intent and purpose that accidents may be prevented; and also to bear and pay the expenses, damages, or compensation incident thereto, either severally or in such proportions as the Commission may determine under the provisions of this act.”

k—*Gas, Water and Electric Meters.*—It is the duty of every public service company—

“If a gas corporation, water corporation, or other public service company, furnishing its service or product upon meter or other similar measurement, or electric corporation, to provide and keep in and upon its premises, suitable and proper apparatus to be approved from time to time and stamped or marked by the Commission for testing and proving the accuracy of gas, water, electric or other meters furnished by it for use; and by which apparatus every meter may be tested, upon the written request of the consumer to whomever the same shall be furnished, and in his presence if he shall so desire. If the meter so tested shall be found to be accurate, within such commercially reasonable limits as the Commission may, by general or special order, fix for such meters, or class of meters, a reasonable fee, to be fixed by the Commission, by standing order, sufficient to cover the cost of such test, shall be paid by the consumer requiring such test; but, if not so found, then the cost thereof shall be borne by the public service company furnishing said meter.”

III.—SOME CORPORATE POWERS AND LIMITATIONS—PERTINENT TO ENGINEERING.

a—*Participation in Economies of Method and Service.*—It is lawful for every public service company—

“To participate, to such an extent as may be permitted by the Commission, and deemed by the Commission wise, for the purpose of encouraging economies, efficiencies, or improved methods or service, in the additional profits which will be afforded by such economies, efficiencies, or improvements in methods or service.”

b—*Classification of Service.*—It is lawful for every public service company—

“To employ, in the conduct and management of its business, suitable and reasonable classifications of its service, patrons, and rates; and such classifications may, in any proper case, take into account the nature of, the use and quantity used, the time used, the purpose for which used, the kind, bulk, value, and facility of handling of commodities and any other reasonable consideration.”

c—*Approval of Incorporation.*—Upon approval of the Commission evidenced by its Certificate of Public Convenience, first had and obtained, and not otherwise, it shall be lawful for any proposed public service company—

“To be incorporated, organized, or created.” Also—

“To begin the exercise of any right, power, franchise, or privilege under any ordinance, municipal contract, or otherwise.”

d—*Additional Franchises.*—Upon approval of the Commission evidenced by its Certificate of Public Convenience, first had and obtained, and upon compliance with existing laws, and not otherwise, it shall be lawful—

“For any public service company to renew its charter, or obtain any additional rights, powers, franchises, or privileges, by any amendment or supplement to its charter, or otherwise.”

e—*Merger or Consolidation.*—Also upon like approval of the Commission, first had and obtained, as aforesaid, and upon compliance with existing laws, and not otherwise, it shall be lawful—

“For any public service company to sell, assign, transfer, lease, consolidate, or merge its property, powers, franchises, or privileges, or any or all of them, to or with any other corporation or person.”

f—*Municipal Plant.*—Also, upon like approval of the Commission, first had and obtained, as aforesaid, and upon compliance with existing laws, and not otherwise, it shall be lawful—

“For any municipal corporations to acquire, construct, or begin to operate, any plant, equipment or other facilities for the rendering or furnishing to the public of any service of the kind or character already being rendered or furnished by any public service company within the municipality.”

“PROVIDED, however, that nothing herein contained shall interfere with or effect the right or power of a municipal corporation to continue the operation of its municipal plant, or to extend the same, within the territory of such municipal corporation, or any part thereof, which is not being sufficient by a public service company rendering or furnishing service of a like kind or character: And provided further, that any municipal corporation, which at the time this act becomes effective, has, by authority of law, in process of construction any such plant for the rendering or furnishing to the public of any such service, may proceed with and complete the said construction, and begin to operate the same, without the aforesaid approval of the Commission first had and obtained.”

g—*Commission's Valuation and Certificate.*—It is lawful for any public service company—

“To issue stocks, trust certificates, bonds, notes, or other evidences of indebtedness or other securities, or make any increase in the issue thereof, in the manner prescribed by law, for and only for money, labor done, or money or property actually received, in accordance with the requirements of the Constitution and the laws of the Commonwealth.”

“Application as hereinafter provided may be made by such public service companies to the Commission for a Certificate of Valuation, to the effect that the provisions of this section have been complied with as to any stocks, trust certificates, bonds, notes, or other evidences of indebtedness or other securities, issued after the passage of this act; such application shall certify as to the number and amount thereof to be issued and the purpose of such issue, and shall contain such other facts and detailed information, and be in such form, as the Commission shall determine and prescribe, and shall be signed and verified by the affidavit of the treasurer, auditor, controller, or other acting fiscal head of the public service company.”

h—*Construction of Crossings.*—It is lawful for any public service company—

“Upon the approval of the Commission, evidenced by its Certificate of Public Convenience first had and obtained, and not otherwise, it shall be lawful for any railroad corporation or street railway corporation to construct its tracks or other facilities across the tracks or other facilities of any other railroad corporation or street railway corporation, or across any public highway, at grade, or above or below grade, or for any public highway to be constructed across the tracks or other facilities of any railroad corporation or street railway corporation, at grade, or above or below grade; or for any public service company to construct any of its facilities across the facilities of any other public service company at the same or different levels. And it shall be lawful, upon like ap-

proval first had and obtained, and not otherwise, for any public service company to alter, relocate, remove, or abolish any such crossing: **PROVIDED**, however, that in all cases in which the tracks or other facilities of a railroad corporation or street railway corporation across the tracks or other facilities of another railroad corporation or street railway corporation or a public highway at grade, and such crossing is at the time, this act becomes effective in process of abolition, under and in accordance with an agreement or contract entered into with any municipality providing for such abolition, it shall be lawful to proceed with the consummation of such abolition as provided in such agreement or contract, without the aforesaid approval of the Commission first being obtained."

i—*Capitalization*.—It is unlawful for any public service company—

"To capitalize its franchises, rights, powers, privileges, or right to own and operate or enjoy any such franchises, rights, powers, or privileges, in excess of the amount paid to the Commonwealth or any political subdivision thereof as the consideration for the grant thereof; or to capitalize any lease, or contract of sale, or contract for consolidation or merger of two or more public service companies; or to issue by way of substitution any capital stock, trust certificates, bonds, notes, or other evidence of indebtedness or other securities, for any consolidated or merged company, exceeding the aggregate values of the properties of the companies so consolidated or merged, and any additional sum actually paid in, in cash, and any additional property or labor actually contributed: **PROVIDED**, That any such public service company or companies may apply to the Commission to determine such consideration or values aforesaid."

j—*Issue of Securities by Reorganized Companies*.—It is unlawful for any public service company—

"In the case of any reorganization under the provisions of the Act of Assembly approved the eighth day of April, Anno Domini, one thousand eight hundred and sixty-one, entitled 'An act concerning the sale of railroads, canals, turnpikes, bridges, and plank roads,' or any supplement thereto or amendments thereof, to issue any stock, trust certificates, bonds, notes, or other evidences of indebtedness or other securities, in excess of the amount paid or agreed to be paid to the Commonwealth or any political subdivision thereof, as the consideration for the grants of any franchises, rights, powers, or privileges and the value of the property of such reorganized corporation (and any additional sum actually paid in cash and any additional property or labor actually contributed): **PROVIDED**, That any such public service company may apply to the Commission to determine such consideration or value, aforesaid."

k—*Contracts and Agreements*—

"No contract or agreement between any public service company and any municipal corporation shall be valid unless approved by the Commission: **PROVIDED**, That, upon notice to the local authorities concerned, any public service company may apply to the Commission, before the consent of the local authorities has been obtained, for a declaration by the Commission of the terms and conditions upon which it will grant its approval of such contract or agreement, if at all."

IV.—THE PUBLIC SERVICE COMMISSION—ITS POWERS AND DUTIES PERTINENT TO ENGINEERING.

a—*Officers.*—The law creating and establishing The Public Service Commission of the Commonwealth of Pennsylvania, provides—

“The Commission shall have power to employ during its pleasure, and at such rates of compensation as it may determine, such officers, experts, engineers, statisticians, accountants, inspectors, clerks, and employees as it may deem necessary to carry out the provisions of this act, or to perform the duties and exercise the powers conferred upon the Commission.”

b—*Qualifications and Restrictions.*—The law provides—

“No person shall be appointed a member of the Commission, or hold any place, position, or office under it, who occupies any official relation to any public service company doing business in this Commonwealth, or who holds any other appointive or elective office of the Commonwealth or any municipality thereof. No Commissioner shall during his term be a candidate for any such office.”

“No Commissioner and no employee, appointee, or official engaged in the service of, or in any manner connected with, said Commission, shall hold any office or position, or be engaged in any business, employment or vocation, the duties of which are incompatible with the duties of his office or employment as Commissioner, or in the service or in connection with the work of the Commission. No Commissioner shall participate in any hearing or proceeding in which he has any direct or indirect pecuniary interest. Every Commissioner, the said secretary, attorneys, marshal and investigator of accidents, and every individual employed or appointed to office under, in the service of, or in connection with the work of, the Commission, is hereby forbidden to solicit, suggest, request, or recommend, directly or indirectly, to any public service company, or to any officer, attorney, agent, or employee thereof, the appointment of any individual to any office, place, or position in, or the employment of any individual in any capacity by, said public service company.”

c—*Bribery.*—The law provides—

“Every public service company and every officer, attorney, agent, or employee, is hereby forbidden to offer to any Commissioner, the said secretary, attorneys, marshal, or investigator of accidents, or to any person appointed or employed by the Commission, to any office, place, appointment, or position; or to offer to give any Commissioner, the said secretary, attorneys, marshal or investigator of accidents, or to any person employed in the service of the Commission or in connection with the work of the Commission, any free pass or transportation, or any reduction in fares to which the public generally is not entitled, or any free carriage of property or any present, gift, or gratuity, money or valuable thing of any kind.”

d—*General Administrative Powers.*—The Commission has general administrative power and authority, to supervise and regulate all public service companies doing business within the Commonwealth.

“Said power and authority shall include the power to inquire into and regulate—

1. *SERVICE AND RATES.*—“The service, rates, fares, tolls or charges of any and all public service companies including individual and joint rates, the charges for long and short transmission of messages and conversations by telegraph and telephone companies;”

2. *EXTENSIONS.*—“The making of repairs, alterations and improvements in and to such service; as shall be reasonably necessary for the accommodation or safety of its patrons, employees, and the public;”

3. *TRANSFERS.*—“The granting of transfers to or from one part of the system of the same common carrier to another part;”

4. *ROUTING.*—“The routing of the lines of street railways, under the provisions of the act, entitled ‘An act authorizing traction or motor power companies, and street passenger railway companies, owning, leasing, controlling, or operating different lines of street railways, to operate all of said lines as a general system, and to lay out such new routes or circuits over the whole or any part of the street or streets occupied by such different companies, and to run cars thereon for such distances and in such directions as will in the opinion of the operating company, best accommodate public travel,’ approved the fifteenth day of May, Anno Domini, one thousand eight hundred and ninety-five (Pamphlet Laws, sixty-five), or otherwise;”

5. *DISTRIBUTION OF CARS.*—“The just and equitable distribution of trains, cars, vehicles, and motor power, or other facilities, of all common carriers;”

6. *SWITCHES.*—“The granting, construction, operation, or discontinuance of switches, sidings, and crossings;” “The construction, operation, or discontinuance of switch connections with or between lines of railroad corporations;”

7. *FACILITIES.*—“The location or abolition of freight and passenger stations, wharves, docks, or piers; the use and compensation for cars owned or controlled by persons other than the carrier; the safety, adequacy and sufficiency of the facilities, plant, and equipment for the carrying on of their business by said public service companies; the quantity or quality of water, gas, electricity, or light, heat or power, supplies;”

8. *SECURITIES.*—“And as specifically provided in their act, the issuing of stocks, trust certificates, bonds, notes, or other evidences of indebtedness or other securities by public service companies.”

e—*Service.*—The law provides—

"Whenever the Commission shall determine, after hearing, had upon its own motion, or upon complaint, as hereinafter provided, that the service, facilities, rules, regulations, practices, or classifications of any public service company, in respect to, or in connection with, or employed by, or in the performance of, its public duties within this Commonwealth, are unsafe, inadequate, insufficient, unjust or unreasonable, the Commission shall determine, and specify by an order in writing to be made and filed as hereinafter provided, and to be served as hereinafter provided, upon every public service company to be affected thereby, the just, reasonable, safe, adequate and sufficient service, facilities, rules, regulations, or practices thereafter to be put in force, observed, rendered, used, or furnished in the performance of its duties by said public service company or companies; and thereupon it shall be the duty of every public service company affected by said order to observe and obey said order, and all and every the mandates and requirements thereof."

f—*Connections and Through Routes of Railroads and Railways.*—The law provides—

"The Commission shall have power to require railroad corporations and street railway corporations to construct and maintain such switch or other connections, with or between the lines of other companies of the same character, as are reasonably practicable and as the Commission shall deem necessary and proper for the service accommodation, and convenience of the public; and shall also have power to establish through routes and joint rates and classifications, for the conveyance of persons and property between any two or more points within this Commonwealth, wherever the railroad corporations concerned shall have refused or neglected voluntarily to establish such through routes and joint rates and classifications and to prescribe the just terms and conditions under which said through routes shall be operated: Provided, That, in establishing such through routes, the Commission shall not require any railroad company, without its consent to embrace in such routes substantially less than the entire length of its railroad and of any intermediate railroad, operated in conjunction and under a common management or control therewith, which lies between the termini of such proposed through route, unless to do so would make such through route unreasonably long as compared with another practicable through route which would otherwise be established."

"The Commission shall, in case of failure of the railroad corporations and street railway corporations concerned to agree among themselves upon the division of the cost of construction, maintenance, and operation of the connections thus provided for, or the allowance to be made for the interchange of service, or the appointment of any joint rates, ascertain, and by order prescribe and fix the equitable and just apportionment of division of the same."

"Nothing in this section shall give the Commission power over street railway corporations engaged in the business of carrying passengers, but not engaged in the general business of transporting freight, and which do not generally solicit the transportation of freight as a main branch of their business."

g—*Connection of Telegraph Lines.*—The law provides—

"In the case of a telegraph corporation, or person engaged in the public telegraph business, the Commission may also, whenever it may determine it to be necessary or proper for the accommodation or convenience of the public so to do after hearing had upon its own motion or upon complaint, require any such telegraph corporation or person to permit any other such telegraph corporation, or person engaged in the public telegraph business, to connect its or his lines of telegraph with the lines of telegraph of such first-named telegraph corporation or person; and inter-changeably to receive dispatches from and for each other, and from and for and individual or individuals; and, on payment of its or his usual charges to individuals for transmitting dispatches, as established by the rates and regulations of such telegraph corporations or person, or by the Commission as hereinafter provided, to transmit such dispatches with impartiality and good faith.

h—*Connection of Telephone Lines.*—The law provides—

"Whenever the Commission shall find that there are any two or more telephone companies where lines form a continuous line of communication, or could be made to do so by the construction and maintenance of suitable connections between the several lines at common points, for the transmission of conversations between different localities which are not reached by the lines of either company alone, and that such connections and facilities for the through transmission of conversations, jointly over the several lines, can reasonably be made, and an efficient service can be obtained without injustice to either company, and without substantial impairment or detriment to the service to be rendered by either company, and that a public necessity exists therefor; or shall find that any two or more telephone companies have failed to establish just and reasonable joint rates or charges for through service, by or over several lines so connected, and that such joint rates or charges ought to be established, in order to supply a through traffic and communication between different localities not otherwise provided for, or proffered by the companies in question, or either of them,—the Commission may by its order require that such connection be made and facilities supplied, that through conversations be transmitted thereby; and may prescribe the through line and joint rates and charges to be made and to be used and in force in the future; and shall appoint or approve necessary and proper conditions, rules, and regulations for the joint through traffic, and an equitable apportionment between the several companies of the costs and revenues in connection therewith, and the Commission may fix the same by its order, to be duly served upon the company or companies affected."

i—*Crossings.*—The law provides—

1. At Grade or Above or Below.—"Except in cases in which crossings are in process of abolition at the time of the passage of this act, under agreement or contract, with a municipality as set forth in the proviso of section five of article three of this act, the Commission shall have exclusive power to determine, order and prescribe, in accordance with plans and specifications to be approved by it, the just and reasonable

manner, including the particular point of crossing, in which the tracks or other facilities of any public service company may be constructed across the tracks or other facilities of any other public service company at grade, or above or below grade, or at the same or different levels; or in which the tracks or other facilities of any railroad corporation or street railway corporation may be constructed across the tracks or other facilities of any other railroad corporation or street railway corporation, or across any public highway at grade, or above or below grade; or in which any public highway may be constructed across the tracks or other facilities of any railroad corporation or street railway corporation at grade, or above or below grade; and to determine, order and prescribe the terms and conditions of installation and operation, maintenance, of all such crossings which may now or hereafter be constructed, including the stationing of watchmen thereat, or the installation and regulation of lights, block or other system of signaling, safety appliances, devices, or such other means or instrumentalities as may to the Commission appear reasonable and necessary,—to the end, intent, and purpose that accidents may be prevented and the safety of the public promoted.”

2. **APPROVAL.**—“No such crossing shall be constructed without the approval of the Commission, evidenced by its “Certificate of Public Conveniences,” as provided in section five of article three of this act; but in no case shall the approval or consent of any court, board, or other commission or officer, or of any municipality, be necessary therefor.”

3. **GENERAL RULE.**—“It shall be proper, however, for the Commission by general rule or order, whenever the same can be properly regulated by suitable general rule, to prescribe the terms and conditions under which such crossing may be constructed, operated, maintained, or protected, without the particular approval of the Commission.”

4. **RELOCATION, ALTERATION, ABOLITION.**—“The Commission shall also have exclusive power, upon its own motion or upon complaint, and after hearing as hereinafter provided (of which all the parties in interest, including the owners of adjacent property, shall have due notice), to order any crossing aforesaid, non-existing or hereafter constructed at grade, or at the same or different levels, to be relocated or altered, to be abolished, according to plans and specifications to be approved and upon just and reasonable terms and conditions to be prescribed, by the Commission.”

5. **COMPENSATION FOR DAMAGES.**—“The compensation for damages which the owners of adjacent property, taken, injured or destroyed may sustain in the construction, relocation, alteration, or abolition, of any such crossing specified in this section (for which compensation the said owners are hereby invested with warrant of authority, upon appeal from the determination of the Commission to sue the Commonwealth), shall, after due notice. A hearing, be ascertained and determined by the Commission; and such compensation, as well as the expense of the said construction, relocation, alteration or abolition of any such crossing, shall be borne and paid, as hereinafter provided by the public service company or companies or municipal cor-

porations concerned, or by the Commonwealth, either severally or in such proper propositions as the Commission may, after due notice and hearing, in due course determine, unless the said proportions are mutually agreed upon and paid by those interested as aforesaid."

6. **TERMS AND CONDITIONS.**—"In prescribing the terms and conditions, upon which any such crossing may be constructed or relocated, or altered or abolished, and the proportionate contributions to the expense thereof, including the damages or compensation to the owner of adjacent property, as aforesaid, the Commission may, among other things, take into consideration the relative importance to the public of the services rendered by the public service companies concerned, as well as the priority of location: **PROVIDED**, That where any portion of the cash and expense thereof shall have been or shall be borne in the future by the Commonwealth or any municipal corporation, such portion shall not be taken into account by the Commission in fixing any valuation, for any purpose, under any of the provisions of this act: **AND PROVIDED FURTHER**, That where the order of the Commission shall, as part of the regulation of the construction, relocation, alteration or abolition of any crossing aforesaid, require, as incidental thereto, a relocation, changes in or removal of any adjacent structures, equipment or other facilities of any telegraph, telephone, gas, electric light, water-power, water pipe-line, or other public service company, said company shall, at its own expense, relocate, change or remove such structures, equipment, or other facilities, in conformity with the order of the Commission; and in default of compliance with such order, the Commission shall cause the work and materials to be done and furnished in accordance with the said order, and may recover the cost and expense thereof from the said public service company."

7. **FINAL ORDER.**—"Before the Commission shall make any final order relative to the construction, relocation, alteration or abolition of any crossing involving any public highway or street, an effort shall be made by the Commission to reach an agreement with the proper officials of the municipal corporations concerned, determining the plans and specifications governing such crossings; and, in default of such agreement, the Commission shall exercise the exclusive power vested in it under this section and shall finally determine and adopt the complete plans and specifications and locate all lines and grades in said public highways and streets, and may permit the public service company or companies, or the municipal corporation to do the whole or any portion of the work in accordance therewith; otherwise the Commission shall do the work by contract or contracts, to be awarded, after due advertisements, to the lowest responsible bidder in accordance with the said plans and specifications."

8. **RIGHTS OF CONTRACTOR.**—"The said contractor shall be authorized, in the name of the Commission, to collect by due process of law from the public service company or companies or the said municipal corporation, or from the Commonwealth, either severally or proportionately as may be determined by the Commission, the amount which may be justly due him under the terms of his said contract with the Commission; and any amount so determined to be paid the said contractor by the Commonwealth, as well as the amount of damages or compensation determined and awarded to be paid the owners of adjacent property, as aforesaid, shall in each instance be paid by the State Treasurer, or

a warrant drawn by the Auditor General, upon the presentation to that officer of a statement setting forth the amount determined to be paid as aforesaid, duly certified by the Commission, said payment to be paid out of any funds specifically appropriated for the improvement of the roads or highways of the Commonwealth; and in case of a verdict and judgment thereon for the damages or compensation, recorded by any such adjacent property owned upon appeal, the same shall be paid out of any funds appropriated as aforesaid; and any court of common pleas hearing and determining said appeal is hereby authorized and empowered to issue a writ of mandamus to said Commission, the Auditor General and the State Treasurer, or any of them as the case may require, for the payment of such judgment."

9. **RECOVERY BY THE COMMISSION.**—"The Commission shall have the right to recover, for and on behalf of the Commonwealth, by due process of law, as debts of like amount are now by law recoverable from the public service company or companies, or municipal corporations, in such amounts or proportions against each as may be determined by the Commission, as aforesaid, the amount of the damages or compensation awarded to the owners of adjacent property by the Commission, or by the Court of the proper county on appeal, and the amounts so recorded shall be paid into the State Treasury for the improvement of the roads of the Commonwealth."

j—*Standard of Service.*—The law provides—

"The Commission may, after hearing had upon its own motion or upon complaint, establish such standards of facilities and service of public service companies as shall be reasonably necessary for the safety, accommodation, or convenience of its patrons, employes, and the public; and require, by an order to be served in the manner hereinafter provided upon every public service company affected thereby, the facilities or service of such public service companies to conform to such standards. The Commission shall also have power, after hearing had upon its own motion or upon complaint, to require public service companies to make all such repairs, changes, alterations, extensions, and improvements, in and about their facilities and service, as shall be reasonably necessary and proper for the safety, accommodation, convenience, and service of their patrons, employes, and the public."

k—*Reports, Records, Maps.*—The law provides—

"The Commission shall at all times have access to all accounts, records, and memoranda kept by public service companies; and may designate any of its officers or employes, who shall therefore have authority to inspect and examine any and all accounts, records, and memoranda kept by such public service companies. The Commission shall also have power to require the making and filing with it of all reports, records, maps, documents, data, and information, whenever it deems the same necessary and proper in the public interest or to carry out the provisions of this act: PROVIDED, That where any municipal corporation is engaged in rendering or furnishing to the public any service of the kind or character rendered or furnished by public service companies, the provisions of this section shall apply to said municipal corporation with respect to such service."

l—*Facilities and Service.*—The law provides—

“If the Commission shall find it necessary and proper to the rendering of reasonably safe and adequate or sufficient service it may, and shall after hearing had upon its own motion or upon complaint, make an order, to be served as hereinafter provided upon every common carrier to be effected thereby, requiring all such common carriers to revise and change the time schedules of such common carriers; to alter the running time of trains, cars, vehicles, or boats, or changes in the routes of street railway lines or systems; or regulating or requiring the furnishing and distribution of cars, trains, vehicles, boats, motive power, or other facilities, without undue or unreasonable discrimination or preference between shippers, localities, or competitive or non-competitive points; and the switching, loading, and unloading of said trains, cars, vehicles, boats, or other facilities; the weighing or billing of cars and of property offered for shipment; or regulating demurrage charges, track storage charges, package-room or baggage-room charges, and package or baggage transfer rates and charges; and, generally, to make such other arrangements and improvements in service and facilities as shall be just and reasonable, having due regard to the needs of the public under all the circumstances presented.”

m—*Public Convenience or Safety.*—The law provides that when application is made to the Commission by any public service company for any approval under any provisions of this act; or when application is made to the Commission by any municipal corporation for the approval required by the provisions of article three, section three (d), of this act—

“Such approval, in each and every such case, or kind of application, shall be given only if and when the said Commission shall find or determine that the granting or approval of such application is necessary or proper for the service, accommodation, convenience, or safety of the public.”

n—*Certificate of Public Convenience.*—Continuing the law further provides—

“For the purpose of enabling the Commission to make such finding or determination it shall hold such hearings, which shall be public, and subpoena and examine such witnesses, and compel the production of and examine such witnesses, and compel the production of and examine such books, papers, contracts, or other documents, and make such inquiries, physical examinations, valuations, and investigations as it may deem necessary or proper, in enabling it to reach a determination. Due notice of every such hearing shall be given, and in every case the Commission shall make a finding or determination in writing, stating whether or not its approval is given and, if given, shall issue its certificate, to be known as its Certificate of Public Convenience, under its seal, and file among its records a duplicate of every such certificate.”

o—Determination of Fair Value of Property—

1. **AUTHORITY.**—"The Commission shall have power, upon application or upon its own motion, to ascertain and determine the fair value of the property of every public service company in this Commonwealth, and to determine any matter in connection therewith; and shall exercise the said power whenever the same is required, or whenever it shall deem such valuation or determination necessary or proper under any of the provisions of this act."

2, 3, 4, 5, 6. **HOW DETERMINED—ORIGINAL COST—BONDS AND STOCKS—EARNING CAPACITY—REPRODUCTION COSTS.**

—"In ascertaining and determining such fair value, the Commission may determine every fact, matter, or thing which, in its judgment, does or may have any bearing on such value; and may take into consideration, among other things, the original cost of construction, particularly with reference to the amount expended in the existing and useful permanent improvements; with such consideration for the amount in market value of its bonds and stocks, the probable earning capacity of the property under particular rates prescribed by statute or ordinance, or other municipal contract, or fixed or proferred by the Commission, and for the items of expenditures for obsolete equipment and construction, as the circumstances and the historical development of the enterprise may warrant; the reproduction cost of the property, based upon the fair average price of materials, property, and labor, and the development and going concern value of such public service company; and these, and any other elements of value, shall be given such weight by the Commission as may be just and right in each case."

7. **REVALUATIONS.**—"The Commission shall also have power to make revaluations of the property of any public service company, from time to time, and to ascertain and determine the value of new construction, extensions, and additions to the same."

8. **RULES.**—"The Commission shall have power to establish reasonable general or special rules with respect to the preparation of such valuations, the forms to be followed, the inventories and statements and proofs of original cost to be made, and all other matters, figures, data, and information in connection therewith."

p—Certificate of Valuation.—The law further provides, when application shall be made to the Commission by any public service company—

1. **FRANCHISE.**—"For the ascertainment and determination of the amount paid or agreed to be paid to the Commonwealth, or any political sub-division thereof, as the consideration for the grant of any franchises, rights, powers, privileges, or right to own or operate or enjoy any such franchises, rights, powers, or privileges."

2. **CONSOLIDATION AND MERGER.**—"Or for the ascertainment and determination of the aggregate values of the properties of any public service companies consolidated or merged;"

3. REORGANIZATION.—“Or for the ascertainment and determination of the value of the property of any public service company reorganized, under the provisions of an act of Assembly approved the eighth day of April, one thousand eight hundred and sixty-one, entitled ‘An act concerning the sale of railroads, canals, turnpikes, bridges, and plank roads,’ or any supplement thereto or amendments thereof;”

4. STOCK INCREASE.—“Or for a certificate that the provisions of paragraph (a) of section four of article three of this act, relating to the issuing of stocks or making any increase in the issue thereof by public service companies, have been complied with;”

5. PROPERTY OR LABOR.—“Or for the ascertainment and determination of the value of any property or labor, for which any bonds, notes, or other evidences of indebtedness, running for more than twelve months, are issued;”

6. PUBLIC HEARINGS.—“Or for the ascertainment and determination of the value of any other fact, matter, or thing of which the Commission is authorized to ascertain and determine the value under the terms of this act,—then, and in every such case, for the purpose of making such ascertainment or determination of value, the Commission shall hold such hearings, which shall be public, and subpoena and examine such witnesses, and compel the production of, and examine such books, papers, or other documents, and make such inspections, inquiries, physical examinations, valuations and investigations, as it may deem necessary or proper to enable it to reach a determination. Due notice of every such public hearing shall be given, and in every such case the Commission shall make a finding or determination in writing, stating the value ascertained by the Commission, and shall issue its certificate, to be known as its Certificate of Valuation, under its seal, and file among its papers a duplicate of every such certificate. Any such findings or determinations shall be subject to the right of rehearing and appeal, as hereinafter provided.”

7. REHEARING AND APPEAL.—“The issuing by the Commission of any Certificate of Public Convenience or any Certificate of Valuation, enumerated or provided for in this act, or any finding, determination, or order made by the Commission, refusing or granting such certificates, shall not be construed to revise or validate any lapsed, terminated, invalidated, or void powers, franchises, rights, or privileges; or to enlarge or add to the rights, powers, franchises, or privileges contained in any charter, or in the grant of any franchise or any supplement or amendment to any charter, or to waive or remit any forfeiture.”

8. WHAT A CERTIFICATE IS AND IS NOT.—The issuing by the Commission of any Certificate of Valuation, enumerated or provided for in this act, shall be deemed to certify only to the fact that said securities were issued for money, labor done, or money or property actually received; and shall not be taken as requiring the Commission, in any subsequent valuation of the property of any public service company, for the purposes of ascertaining the amount to be paid to said public service company for its property, to fix a valuation which shall be sufficient to yield a return to the holders of said securities; neither shall said Certificate of Valuation be deemed to require the Commission, in subsequently determining the rates to be charged for the service of said public service company, to provide a rate which shall be sufficient to yield a return on said securities.”

PART TWO

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PART TWO

BUREAU ORGANIZATION AND ADMINISTRATION.

1. BUREAU STAFF.

The following is a detailed statement of the operations of the Bureau of Engineering to the end of the fiscal year June 30th, 1914, being the first annual report made by the Bureau.

The Public Service Commission of the Commonwealth of Pennsylvania (created under the provisions of Act No. 854, approved July 26, 1913, effective for all purposes January 1, 1914, entitled The Public Service Company Law) established the Bureau of Engineering on April 1st, 1914, and appointed F. Herbert Snow, C. E., to be Chief of the Bureau.

The writer immediately assumed the duties of his office.

John B. F. Laurie, former draftsman of the Pennsylvania Railroad Commission, was assigned to the Bureau Staff.

Addison C. Gumbert, appointed to the position of Inspector of Meter Provers, was also assigned to the Bureau Staff. At the end of the fiscal year, Mr. Gumbert had not fairly started on his work of testing meter provers; but he had been engaged on special work preparatory to field operations.

For several days in April, John C. Reed, Electrical Engineer, and H. E. Stephenson were employed on special expert investigations. Mr. Reed reported on the Ashland and Exeter light and power plants.

M. Irene Cuenot was appointed chief stenographer May 1st. Additional stenographic and clerical assistants have been furnished from the Secretary's office as requested.

In June R. H. Fernald, M. E. and professor at the University of Pennsylvania, and L. H. Harris, E. E. and professor at the University of Pittsburgh, were added to the Bureau Staff, in the capacity, however, of consulting engineers. These two experts in their respective specialties rendered conspicuous service to the Commission prior to the creation of the Bureau, as fully described in Part 3 of this report.

Professor H. E. Ehlers, who assisted Prof. Fernald in preparing the rules and regulations to govern certain public utilities, was assigned to active field work for the Bureau in June. He begun investigations of gas, water and heating utilities. Professor Harris at the same time investigated electrical utilities. An account of this work may be found in Part 3.

The scheme of Bureau organization is outlined in the diagram shown on the following page.

2. OFFICE WORK.

The Bureau has occupied Room No. 327, centre wing, third floor of Capitol, adjoining the other rooms used by the Commission. These accommodations are being rapidly outgrown. Additional and suitable quarters must be obtained for the testing laboratories. Arrangements have been made for the temporary use at the University of Pittsburgh of its electrical standard testing apparatus, but finally for efficiency and economic management, the standardizing laboratories for testing electrical, water and gas standards will have to be erected and maintained at a central point,—without doubt, Harrisburg.

The work of the office force for the first three months of the Bureau's existence, has been gradually crystallizing into form and classification. The duties of a chief clerk have been performed by the chief stenographer and by the draftsman; in fact both making themselves generally available. The Chief of the Bureau also has had to turn his hand to work which it will not be profitable for him to perform when the Bureau Staff is sufficiently augmented.

Besides routine matters such as correspondence, filing, plan registers, etc., references to and help given the several bureaus of the Commission, listing of utilities and the preparation and use of blank forms for administering and recording purposes, there are special matters, such as petitions and complaints regarding service and facilities of utilities which are referred to the Bureau. The following is a list of such petitions and complaints.

Serial Number.	Date received.	Cause of Complaint.	Locality.	Utility.
1	4-20	Dangerous wire crossing, .	Catherine Twp.,	Penn Central L. & P. Co.
2	4-21	Dangerous wire crossing, .	Mapleton,	Penn Central L. & P. Co.
3	4-21	Dangerous wire crossing, .	Mt. Union,	Penn Central L. & P. Co.
4	6-17	Dangerous wire crossings, .	Petersburg,	Penn Central L. & P. Co.
5	5-1	Inferior plant and service,	Exeter,	Citizens El. Ill. Co.
6	5-1	Defective meter and excessive charges,	Clearfield,	Penn Public Ser. Co.
7	5-4	Inadequate service,	Harrisburg,	Susquehanna Water Co.
8	5-5	Unsafe condition,	Harrisburg,	Peoples Bridge Co.
9	5-21	Poor facilities, toilet, etc.	Gettysburg,	Western Maryland Railroad.
10	5-28	Dangerous wire crossings, .	St. Benedict,	Penn Central L. & P. Co.

The initiation of the Commission also creates work for the Bureau. For instance, the preparation of rules and regulations for governing public service companies and the preparation for administering them were a very considerable task. Reference for particulars may be had to Part 3 of this report; also to Section 10 of Part 2.

In one case, namely the Port of Philadelphia matter, the scope included such a large physical territory and complexity of interests coming within the jurisdiction of the Commission, and yet all being really the parts of one great plant susceptible to centralized organization and control, it was thought essential that there should be a systematic collaboration of data in relation thereto and its presentation in report form for reference and publication. This has been undertaken by the Bureau and it comprises Part 4 of this report.

The Commission decided to look into the matter of providing that each street car shall carry a jack. Hence hearings were given, testimony was taken, types of devices of this kind were looked up and finally an order was made.

3. BRIDGES.

a—ETNA HIGHWAY BRIDGE.

The bridge in question is on Butler Street over Pine Creek in the Borough of Etna, Allegheny County, and it sustains the double tracks of the Pittsburgh Railways Company and the ordinary traffic of said street. The bridge has a roadway of eighteen feet, one and one-half inches in the clear, and one sidewalk five feet in width, and is sixty feet in length. The superstructure consists of two plate girders of steel five feet in height to which are connected fifteen inch cross beams of steel, spaced six feet six inches on centres. The two tracks of the Pittsburgh Railways Company rest directly on said beams, and the three inch plank floor is supported by 6" x 6" wooden joists, also resting on said cross beams. Said girders are supported by timber grillage from three to four feet in height resting upon masonry and concrete abutments. One of the said abutments near the up-stream end is in a damaged condition. The timber grillage supporting the girders is unsound in part and unsafe.

There is a vertical clearance between the bottom of the main girders and the ordinary water level in the creek of approximately nine feet six inches, but extreme high water in the creek has flooded the surface of the highway at the bridge, which surface is twelve and one half feet above the ordinary water level.

During the last great flood in Pine Creek, heavy floating material was brought down by the waters and lodged against the upper main girder, damaging the abutments and forcing some of the timber grillage out of place, and straining the bridge sufficiently to cause the said main girder to lean over three or more inches out of plumb in its height of five feet. The other main girder, however, retains its true vertical position. The lateral bracing underneath the roadway is partly broken and partly warped. These defects should be remedied without delay.

The structure is known as a thorough girder bridge. That is, the main girders project about two and one-half feet above the roadway, so that the leaning out of plumb of the up-stream main girder, this girder supporting the sidewalk, is very apparent to the passersby, and in consequence disturbs the public sense of security more than if the defect of the bridge were not apparent.

The sectional area for the passage of water underneath the bridge is insufficient to discharge the run-off from the extended and precipitous water shed above, during periods of prolonged and intense rainfalls. Any month of the year a freshet may occur that would further endanger the safety of this structure, and each freshet would necessarily weaken the bridge and its supports.

There is no doubt but that a wider waterway is needed.

Furthermore, Butler Street is a main thoroughfare out into the County, and it is sixty feet wide either side of the bridge and permanently surfaced for the entire width. The traffic is sufficient here to warrant the bridge being sixty feet wide.

The Pittsburgh Railways Company assumes the position of having no responsibility for the maintenance of the existing bridge, except to maintain the surface thereof between its tracks, and twelve inches outside thereof. The Company asserts that it was given permission to lay its tracks over Pine Creek the same as it has been given permission to use the County bridge in other instances. Therefore it has assumed no responsibility for the strength or maintenance of the bridge, except to care for the surface at and near the tracks as previously mentioned.

The bridge is entirely within the Borough limits. The Borough has prepared plans for a new bridge ample in size and sectional area to meet all demands at this place. The Pittsburgh Railways Company assisted in the preparation of these plans, and the Borough has received bids, and ascertained that the cost will be in the neighborhood of \$15,000.00 for the completed structure.

The channel of the stream being changed slightly, the plans will necessarily require the approval of the Water Supply Commission. The main question at this time which concerns the Borough, is whether the Railways Company will share to a material degree in the cost of this improvement. The Railways Company has not declined to pay anything towards the improvement, but the Borough wishes to secure from the Railways Company fifty per cent. of the cost of the improvement, and here the matter lies.

The Public Service Commission notified both the Borough and the Pittsburgh Railways Company that the said bridge at the present time is unsafe and that the foundations and timber supports of the bridge shall forthwith be made ample and secure. Also that the Pittsburgh Railways Company be directed to make a critical examination of the girders and beams and lateral bracing of the bridge, and to put the same into first class condition at once.

It appears that the bridge was erected by the said Pittsburgh Railways Company principally for its own use, since its heavy cars could not have been safely supported by the structure which originally existed over Pine Creek at this place, and hence the suggestion hereinbefore made, that the Company be directed to put this bridge in first class condition.

b—THE PEOPLE'S BRIDGE OVER SUSQUEHANNA RIVER.

About twenty-five years ago or more, the present steel truss bridge spanning the Susquehanna River opposite Walnut Street, Harrisburg, Dauphin County, was constructed. It is now owned by the Peoples Bridge Company of Harrisburg.

The Valley Railways Company has acquired the right to operate and maintain a trolley track on this bridge. This Railways Company sells to other trolley companies the privilege of operating cars on said tracks, and it is via this structure that all street cars enter Harrisburg from the Cumberland Valley side of the river.

When the bridge was designed and erected, heavy eight truck street cars were not in existence. Traffic has increased and necessarily the live load on the bridge, until at the present time the structure is not considered safe by the public, although there is a sort of assurance that the bridge must be sound and safe, or the owners would not permit it to be used.

There has been desultory maintenance of the structure. Four or five years ago some of the piers had deteriorated to such an extent that upon investigation by experts the structure was declared to be in a dangerous condition. Repairs were made, large portions of some of the abutments being entirely rebuilt. Since then, and not infrequently, some member of the superstructure fails or repairs are made that temporarily suspends traffic.

On complaint made to The Public Service Commission the Peoples Bridge Company was required to employ a competent bridge expert who shall be satisfactory to the Commission, to make a thorough examination and report as to the conditions, stability and safety of the abutments, piers and superstructure. A copy of this expert's report was required to be submitted to The Public Service Commission.

4. COMMON CARRIERS.

a—GETTYSBURG PASSENGER STATION.

This matter was investigated upon complaint regarding inadequate facilities at the passenger station of the Western Maryland Railway Company at Gettysburg, Adams County, Pa.

This station is open early every morning. On the day of inspection at 6 A. M., the floors had not been swept nor the platform outside. The toilets presented a neglected appearance, the windows were not screened and the wash bowls had not been cleaned for some time. Plastering in spots had fallen down and the walls were dirty.

Running water is provided for cleansing the hands, paper is furnished as towels, there is drinking water in the waiting rooms, a telephone booth, telegram blanks and seats.

The platforms outside of the station rooms are of concrete. They were widened and extended last year to accommodate the crowds during the Fiftieth Anniversary Celebration of the Battle of Gettysburg. At one end of the platform, but back from it, there is a lavatory with nine seats on either side connected to the public sewer system and provided with running water and flush closets. This building is kept locked and is used on special occasions only.

There is no platform on the opposite side of the tracks from the station but the railroad right of way is in a public street and the buildings front on the street and there is a sort of a side walk parallel to and opposite to the station platform which is used by the owners and occupants of the buildings on that side of the street and upon which passengers may alight.

Gettysburg has a population of about 4,500 people. The station is amply commodious for a town of this size and for the excursions which are made to Gettysburg during the open season. If the company would exercise greater care in maintaining the existing station, if it first made presentable in appearance and thereafter kept clean there would be no sufficient cause for complaint relative to facilities at the station. The company was requested to put its station and entire premises in a sanitary and presentable condition, and to maintain the same in conformity with modern health regulations.

5. ELECTRIC LIGHT AND POWER PLANTS.

a—ASHLAND.

An inspection was made of the plant of the Edison Electric Illuminating Company of Ashland, Schuylkill County, which plant is now owned and operated by the Eastern Pennsylvania Light, Heat and Power Company, Pottsville, Pennsylvania.

Mr. Reed reported as follows:

Power House.

I arrived in Ashland about noon of Thursday, the 2nd inst. and after calling at the local office of the Company, inspected their power house. I found the power house located along the railroad track with handy facilities for unloading coal and consists in general of the following equipment:—

BOILERS.—Two return tubular boilers either of which can operate the entire plant. The fire under one boiler being banked and is only used when drawing the fire under the other boiler. This is a precaution not often taken by such small plants. Rice coal worth about \$1.17 per ton delivered, was being fired. Water for use in the boilers is purchased from the borough.

MACHINERY.—One Allis Corliss Valve, single cylinder non-condensing engine, direct belted to a two phase, 60 cycle, 2,300 volt, 45 ampere, 200 K. W. 600 R. P. M generator. This engine and generator is operated in the evening and whenever the load is sufficient to necessitate it.

One Buckeye engine running about 250 R. P. M. was direct belted to a 22.5 ampere, 2,300 volt, 50 K. W. two phase generator. This set is operated during the day and whenever the load is not heavy enough to necessitate the larger set.

STREET LIGHTING EQUIPMENT.—Two 7.5 ampere, 2,350 volt Adams Bagnall constant current series transformers used in connection with alternating current series arc lamps.

One 4 ampere, 5,000 volt constant current transformer and rectifier used in connection with direct current Magnitite Street Arc Lamps.

SWITCH-BOARDS.—The switch-boards were first class and the wiring good. The station is kept neat and is operated in a business like manner.

ATTENDANCE.—There were two men in attendance—one firing the boilers and oiling—the other tending the switch-board.

I was informed that two men are in attendance from 12 o'clock noon until twelve o'clock at night and one man on the other shift.

One outside repairman and lamp trimmer. One lady clerk at the office located on the main street of Ashland.

One foreman in charge of the station and equipment.

The company has construction men who work at all the various places in which they do business.

Lines.

The primary lines, transformers and most of the secondary lines for supplying commercial lighting and power are strung on poles placed in the alleys between the streets and the service is brought into the rear of the buildings, thus there are no unsightly service wires on the principal streets which usually detract from the appearance of the street. The only lighting lines on the streets being a single line for supplying street arcs, and these only on the side streets. The construction work is first class, most of it impressed me as not being more than two or three years old. The poles are set straight and guyed wherever necessary and the lines well drawn. They have erected poles and placed lines so as to be able to render service to all parts of the borough.

Borough Contract.

The town is especially well lighted, there being 56 arc lights and 58 series, 60 candlepower incandescent lamp. Their contract with the borough, which I understand, has five or six years to run yet calls for a charge of \$85.00 per lamp for the arc lamps and 9 cents per night for the incandescent lamps. The charge for the arc lamps is too high and I was informed that the company have offered to replace all of the old Adams-Bagnall street lamps with the more modern Magnetite lamps, which will give more than twice the amount of light and reduce the price from \$85.00 to \$60.00 per lamp per year, the same price they are charging elsewhere. The borough should accept this offer since it will save them \$1,400 per year and they will also probably find that they can space their lamps further apart and reduce the number necessary, thus further reducing the expense.

Amount of Business.

The company has 262 business customers,
288 residence customers,
and 12 power customers

in the borough of Ashland and surrounding territory consisting of Cunningham and Butler Township, territory in which they do not have competition.

The total output of their station for 24 hours April 2nd was 1040 K. W. hours. The load during the afternoon was about 10 K. W. and in the evening about 100 K. W. The amount of power sold in the borough of Ashland and in territory in which they do not have competition, for the past three months was as follows: January 16400.0 K. W. hours, February 14147.5 K. W. hours, March 12575.6 K. W. hours. This does not include the power used in street lighting for which they have a contract. It would appear that the amount of business in sight is rather small and it is my opinion that it would not pay another company to put up the equipment to go into competition even if they should succeed in securing the greater part of the business.

General Information.

The Eastern Pennsylvania Light, Heat and Power Company, in addition to furnishing power from this station to Ashland Borough, and certain parts of Cunningham and Butler Townships, in which they have no competition are furnishing power and light in Centralia, Gilberton and Girardville in competition with the Schuylkill Electric Company, which in addition to operating a trolley line from Ashland to Shenandoah and from Girardville to Mahanoy City and from Mahanoy City to Shenandoah also furnish electricity for lighting and power purposes in Girardville, Ashland, (four customers) Centralia, Gilberton and parts of Butler, Cunningham and Mahanoy townships.

This information was given me by Mr. T. J. McAndrews, Superintendent of the Schuylkill Electric Company, who also showed me through their power house in which I found the following equipment:

One —425 KW, DC, Railway Generator, direct connected to single cylinder Corliss engine.

One —300 KW, DC, Railway Generator and one hundred KW—1100 volt, single phase generator belted to Simple Engine.

One —250 KW, 2400 volt, 3 phase generator and one 200 KW Railway generator, belted in tandem to single cylinder Corliss engine.

One —500 KW 2400 volt, 3 phase generator direct connected to Corliss engine.

Three—150 HP Keeler Return Tubular Boilers.

Two —300 HP Keeler Water Tube Boilers.

Two —250 HP Babcock and Wilcox water tube boilers.

They have ample capacity to take care of any increase in load which might be required should they be allowed to do lighting business in the borough of Ashland, and was informed by Mr. T. R. Ettringham, foreman in charge of the interests of the Eastern Pennsylvania Light, Heat and Power Company at Ashland, that they have connected up four customers since the Commissioners issued an order restraining them from doing business in Ashland.

The switch-boards were for the most part of an old type and the power house wiring poor. A considerable portion of their line construction which I noticed in the vicinity of the power house as well as that in the borough of Centralia is far from being first class. I understand that they do not furnish polyphase current in Centralia; in other words they are not in a position to take on anything in the way of power customers except very small motors. Their power house equipment, however, is suitable and it would be only necessary to run the wires.

Rates.

Appended hereto you will find on a light blue paper the rates in force in Ashland as well as other places in which the Eastern Pennsylvania Light, Heat and Power Company do business. These were furnished me by Miss M. E. Russell, the company's lady clerk in charge of the Ashland office. I questioned her in regard to them and asked her if they charged the same rates to all the customers, making special reference to those residing within and without the competitive territory. She assured me they did, also Mr. Wm. H. Long, their contract agent, with whom I talked over the telephone, he being in Pottsville at the time, assured me that they maintained these rates wherever they do business, including the City of Pottsville.

In order to verify this, I went to Centralia, where both companies do business and made inquiry from A. D. Goldsmith, a druggist, who kindly let me see one of his receipted bills and I found it to be in accordance with the established rates.

You will also find appended herewith an application blank for power service which discloses the power rates. The lighting rates of the Schuylkill Electric Company in typewritten form are also appended. This latter sheet does not state the basis rate but it is my understanding that it is ten cents (10c.) per kilowatt hour, and under the flat rates I was informed by Mr. McAndrews previously referred to, that this means 16 candle-power carbon lamps or their equivalent or nothing above 60 watt lamps. Since meters have become so cheap there is not much excuse for having any flat rates.

There is not much difference between the rates of the two companies although the discounts allowed by the Schuylkill Electric Company increases more rapidly than those of the Eastern Pennsylvania Light, Heat and Power Company, and both companies seem to have custom in territory where they compete. There does not seem to be much sense to either company's rates, since there is no sound reason why a large consumer should be allowed a larger discount than a small one; on the other hand, the discount should be allowed for prompt payment and should be the same to all. The rate should be fixed in accordance with the consumption, taken in consideration with the demands of the customer. The rates in force by either company are about what are usually charged and it is my understanding that there are no rate complaints.

Service.

The service of the Eastern Pennsylvania Light, Heat and Power Company in Ashland, so far as I could see, was first-class, better than the average, and the entire layout is much superior than is usually found in towns of this size. Mr. Goldsmith in Centralia stated he cut off from the other company because this company gave the best service. They have a systematic method of taking care of all complaints and their trouble sheets were shown me showing that all complaints were promptly taken care of and the customers satisfied. Their plant being located near the center of the town, they have no voltage drops and since their load is steady the regulation is good.

Conclusions.

It is my opinion that the Borough of Ashland is well served by the Eastern Pennsylvania Light, Heat and Power Company; that the rates are reasonable and that any other entering the field would not be able to secure sufficient business to earn dividends on the necessary investment.

The Schuylkill Electric Company have poles on the principal street of the town but these are too low for properly supporting high tension wires, besides to bring in the same from the front of the houses would greatly mar the appearance of the street and on the other streets the equipment would have to be duplicated from the ground up.

The returns as evidenced from the amount of current sold cannot be very great and if this were greatly reduced it would not be a paying proposition, and would only result in poorer service.

I noticed entire blocks of houses in which there were no domestic customers and others in which there were only one of two customers, although the equipment was at hand to serve them. I was informed that they couldn't get the property owners to wire the houses.

It would seem to me that a town of 7,000 inhabitants having gas and electric lights could not receive any permanent benefits from a second electric light company.

For the good of both companies, I respectively advise against the granting permission to the Schuylkill Electric Company or any other company engaging in competition in the electric lighting business in the borough of Ashland.

JOHN C. REED,
Electrical Engineer.

b—EXETER.

An inspection was made of the equipment for furnishing light to the citizens of the Borough of Exeter, Luzerne County, by the Citizens Electric Illuminating Company of Pittston. This company furnishes light and power in the city of Pittston and surrounding boroughs, including West Pittston and Exeter on the opposite side of

the river from Pittston. All of the territory in this vicinity is supplied by one of three companies whose principal place of business is either Wilkes-Barre, Pittston or Scranton, there being no competition or duplicates of equipment and it would appear that there is no unserved territory as a basis for a new company.

The Borough of Exeter has 2,500 to 3,000 inhabitants and is not closely built up but is widely scattered, making it an expensive proposition for an electric lighting company.

Mr. Reed made the field investigation and he reported as follows:

The Citizens' Electric Illuminating Company has 110 customers in Exeter and it had a contract for supplying 39 street arc lamps for lighting the streets of Exeter. This contract expired several months ago and since then they have been continuing to serve the borough and are charging \$60.00 each per year for the lights, the same as is charged the City of Pittston, although they have not been paid since the first of the year owing to the fact that there are two sets of councilmen and other borough officers.

I made inquiry from a cigar dealer, as to the quality of the service, and he said it was all right and I found his bills in accordance with the established rates of the company.

The current sold exclusive of the street lighting within the borough of Exeter for the month of March, 1914, amounted to 4338 K. W. hours; this information being worked up at my request from the bills, since the Borough of Exeter and the Borough of West Pittston are carried on the same station lines. The above consumption includes five power customers, so it will be readily seen that the business is very small. The company has two phase 60 cycle current and direct current series arc circuits in the Borough.

The line construction is in good shape although not of an expensive nature. There is gas competition in the town.

There is not sufficient business in sight for another company to make a living, in fact, I doubt if it could be shown that it would be a profitable investment for a new company if they had the entire borough to themselves.

The company has a fairly modern power plant of several thousand kilowatts capacity, consisting of steam turbines, operating condensing, and was informed their capacity was twice their maximum load.

I understand there is ample evidence now before the Commissioners to prove that the service is satisfactory, nearly all their customers having signed a paper to that effect.

The Power house is located at no great distance from the borough so there should be no difficulty about the regulation with such a small load. I did not stay over night in the borough of Exeter since I did not consider it necessary.

First—In my opinion the Borough of Exeter is well served with electric light and power.

Second—That another company entering this field would not be a paying proposition.

Third—That the present company cannot be securing more than a fair price on the investment now in the Borough.

Fourth—The introduction of a second company could not result in any permanent benefit to the citizens of Exeter.

I, therefore, recommend that permission for a second company to do electric lighting business in the Borough of Exeter be refused.

JOHN C. REED,
Electrical Engineer.

c—LEBANON VALLEY ELECTRIC LIGHT COMPANY.

An inspection was made of the Lebanon Valley Electric Light Company's plant and facilities. The question up for consideration was the purchase by the Reading Transit and Light Company of the controlling right, title and interest in the said Lebanon Valley Electric Light Company.

The transmission lines and distributing system of the said Lebanon Valley Company are substantially good and serviceable, but the apparatus at the main power plant and at the auxiliary station is not worth much.

Furthermore, in order that the said company may continue its business of furnishing light and power in its present developed territory it will be necessary for it to build an entire new and up-to-date power plant involving an expenditure of \$50,000.00. This outlay would of course be a charge upon the company's consumers. The territory in and about Lebanon is not extensive enough to support two companies operating individual plants. There is no question but that the Reading Transit and Light Company is equipped and capable of furnishing satisfactory service at reasonable rates to all its territory including Lebanon and its environments. The public convenience and necessity would be subserved by the taking over of the plant and property of the said Lebanon Valley Company by the said Reading Transit Company.

Mr. John S. Weaver, the prime mover and principal owner in the incorporation of the subsidiary companies and the merger of them into the said Lebanon Valley Electric Light Company, is a citizen of North Lebanon Township and a manufacturer of bologna sausages. Several years ago he ventured into the field of public water works, and finally sold out at considerable profit. Thus encouraged he took up the proposition of furnishing electric current. He knew nothing of this business and it is evident from a physical inspection of the plant that very poor judgment was exercised. The plant has been developed in a desultory manner; second-hand apparatus has been largely used; the capacity has been inadequate at all times. An auxiliary station was finally erected at the bologna works. Naturally the result of such methods of development is an inferior and totally inadequate power plant. Nevertheless the plant is not totally valueless. It has a net earning capacity of between \$5,000.00 and \$6,000.00 per annum, which capitalized at 6% represents over \$90,000.00.

The main power station is in North Lebanon Township at the edge of Lebanon City. The auxiliary plant is a mile and a half or so distant out in the same Township at the bologna works. The original hydro-electric plant on Swatara Creek has been dismantled. There are approximately 15 miles of main transmission lines and it is

reported that there are about as many more miles of service wires. This distributing system is quite new and in a fairly good condition. The expert who examined the same for the Company has reported the cost of this portion of the plant to be as follows:

Poles, transmission lines and rights of way,.....	\$32,000 00
Street light system,	4,000 00
Transformers,	4,500 00
Meter and service connections,	3,500 00
Total,	<u>\$44,000 00</u>

Forty thousand dollars would be the present value of the distributing system, so it would appear.

The proposed purchase does not include the land, water rights and property on the Swatara Creek. The poles to this property are still standing, but the wires have been taken down for some distance towards Lebanon from the Swatara property, which was the original plant. The wires now terminate at Mountville in North Anville Township, approximately 6 miles in a straight line northwesterly from the main power plant. In an easterly direction from the main power plant the transmission wires now terminate in Myerstown Borough, 6 miles distant. The poles have been erected 3 miles beyond Myerstown to Richland Borough, but the wires have not been strung.

The apparatus and everything connected therewith at the auxiliary station, bologna factory, is to be excluded from the purchase.

At the main station there is a lot 150' long by 113' wide, which cost \$25,000.00. The building, a frame structure, 50' x 70', looks more like a shack than anything else. The lot, building and railroad siding into it, is probably worth \$3,500.00 today. The 450 foot artesian well on the premises is worth \$1,000.00; the two producer gas engines directly connected to generators, having a present value of not over \$10,500.00, although the cost set up was \$25,500.00. On this basis the present value at the main power station is \$15,000.00, added to the \$40,000.00, the distributing system, gives a present value of the entire plant of \$55,000.00. This conclusion is the result of a very hasty and general examination of the property.

There are about 400 customers. Light is sold at 50 K. W. H. net with a minimum of 75 cents per month. The power rate is 4 to 2 cents per K. W. H. net—no minimum. The transformers range from 1.5 to 30 K. W., being mostly from 2.5 to 5 K. W. in capacity. There is a total of about 750 K. W., which at \$6.00 is equivalent to \$4,500.00. Eight dollars is not an unusual figure to estimate as the value K. W. for transformers. The purchasing company proposes to pay for the property to be acquired \$41,500.00 in cash, and \$75,000.00 at face value in common stock of the stock of the Easton Power and Light Corporation. This stock is not listed, but its accepted value among owners is taken at \$20.00 per share. If the stock were listed at this rate it would be equivalent to \$15,000.00, or a total purchase price of \$56,500.00 at this time.

Conclusion.

The present investment in the plant and property of the Lebanon Valley Electric Light Company is approximately \$100,000.00. The distributing system is fairly good and may be valued at \$40,000.00; the power plant at \$15,000.00 making the present value, excluding the Swatara property and the auxiliary station plant, as \$55,000.00.

If the Lebanon Valley Electric Light Company is to continue on in business a new power plant will have to be built at an estimated cost of \$50,000.00; but there is not enough business to warrant such an expenditure on the part of this competing company. For substantially the same price, namely, \$41,500.00 in cash, the Reading Transit and Light Company with adequate plant now in operation will take over the said Lebanon Company's property and operate it.

6. WATER WORKS.

a—SUSQUEHANNA TOWNSHIP WATER COMPANY.

This case was brought up on complaint of David M. Beck against the Susquehanna Township Water Company of Dauphin County, with particular reference to the alleged inadequate service.

The conclusion of the Bureau's investigations were substantially to the effect that the water company is rendering efficient service and that the suspension of service, principally complained about, was due to a cause which is not likely to happen again. When the interruption to service may be remedied by the company where application is made properly to the Company, it is not the proper procedure, in neglecting to so notify the Company, to bring the complaint before the Public Service Commission. Accidents such as breaks in water pipes, followed by temporary suspension of service during repairs, are not sufficient cause for complaint to the Public Service Commission ordinarily. These necessary interruptions daily aggregate throughout Pennsylvania many scores no doubt. They are incident to the management of a water works system, even where the system is new, as in the case at hand.

The complainant resides near the City of Harrisburg line and draws water from a distributing pipe of the Susquehanna Township Water Company at or near the end of this pipe. In consequence, there is more likelihood of entrained air appearing in the water drawn from the pipe. The water company represents that if it becomes necessary, the company will install a blow-off on said pipe to reduce the air in the water to a minimum.

The rates charged for water are less in Susquehanna Township and vicinity than elsewhere in the districts supplied by the Paxtang Consolidated Water Company, which is the main holding and operating company.

About six years ago, the only corporation that supplied water to the public in Susquehanna and Swatara townships, in which townships are the suburbs of Harrisburg, was the Paxtang Water

Company. Its charter was limited to Paxtang village in Swatara Township. The source of supply was drilled wells and the service was inadequate. At that time the Borough of Hummelstown was supplied with water by the Hummelstown Light, Heat and Power Company. The service was unsatisfactory. The Borough of Middletown and vicinity was supplied with water by the Middletown Water Company and the service was unsatisfactory. The State Department of Health took action relative to these three water works systems and improvements had to be inaugurated. Harrisburg's suburbs were growing rapidly and needed public water. A charter had been granted to the Penbrook Water Company for the Borough of Penbrook and to the Progress Water Company for the Township of Susquehanna, but there was no place where a source of supply could be obtained except along the Swatara Creek. This was also true with respect to the Rutherford Heights Water Supply Company, chartered for Susquehanna Township.

The State Departments of Health and Water Supply encouraged the reorganization and consolidation of these companies in order that there might be created a district large enough to warrant the construction of one adequate water works system and in consequence names were changed as hereinafter explained and the Paxtang Consolidated Water Company came into existence as a holding, operating company. It also acquired the controlling interest in the Middletown Water Company, but since there is no physical connection between the Middletown plant and the Susquehanna Township Water Company case, it need not be further mentioned.

The Hummelstown Light, Heat and Power Company changed its name to the Hummelstown Consolidated Water Company. This company built a modern filtration plant, approved by the State Department of Health and operated to its satisfaction. This company today owns this filtration plant, the dam on the Swatara River, the power station and equipment. It supplies power and light and water to Hummelstown Borough. Also it supplies power and water to the Rutherford Heights Water Supply Co. Since the reconstruction of the works, the service has been most excellent in Hummelstown.

There is a minimum meter rate of \$10 per annum and 20 cents per thousand gallons. There are, however, not over twenty meters in the borough. The lowest flat rate is \$6.50 per annum. Water is furnished for fire purposes and domestic use.

In connection with the filter plant, there are duplicate raw water pumps of two million gallons capacity, and a third unit of the same size is being put in. The output at the station averages 1,250,000 gallons per 24 hours. This is the total consumption of all of the water companies mentioned with the exception of the Middletown plant which has no physical connection.

The Rutherford Heights Water Supply Company has installed in the Hummelstown station a 2,000,000 gallon steam pump, a million gallon pump water driven by power from the dam and a million gallon electric driven pump. The filtered water is pumped to Chapman Hill through a 12-inch pipe 5 miles long. This reservoir is circular, covered, re-inforced concrete construction, having a capacity of 1,100,000 gallons. From it water is delivered by gravity through a 12-inch pipe laid along the Hummelstown turnpike to the City of Harrisburg line, a distance of three miles. This pipe passes through Paxtang village.

In Swatara Township is the village of Rutherford Heights and the freight yards of the P. & R. Railway. This Railway Company purchases about 250,000 gallons daily from the water company. The Rutherford Heights Water Supply Company owns the reservoir and pipe lines, excluding those in the village of Paxtang. The water is all purchased on a flat rate basis, \$6.50 being the minimum rate. The minimum meter rate is \$12. per annum. The charge for water is 30 cents per thousand gallons. The Railroad pays 4 cents per thousand gallons.

The Paxtang Water Company changed its name to the Paxtang Consolidated Water Company. It owns the distributing pipes in its charter territory of Paxtang village in Swatara Townships. This is a first class township. The Commissioners thereof have not established fire hydrants service. The fire hydrants have been erected by the company but they are used only as blow-offs. The rates of this company are the same as in the other portion of Swatara Township. Paxtang Consolidated Water Company buys its water of the Rutherford Heights Water Supply Company. This company supplies the public in the trolley park. Mrs. H. F. Kramer was interviewed in her husband's store in Paxtang. She said that the water service was excellent in all respects. At the P. & R. Y. M. C. A. and at Rutherford Heights store similar statements were made as to service.

The Susquehanna Township Water Company is chartered for the entire township. It buys water of the Rutherford Heights Water Supply Company and sells to the Extension Water Company of Penbrook, originally the Penbrook Water Company of Penbrook Borough. Susquehanna Township Water Company was originally the Progress Water Company. It supplies the State Hospital in the suburbs of Harrisburg with 300,000 gallons of water daily. The Superintendent, Dr. Orth, has designated an attendant to take charge of the Institution's water works. This attendant is instructed to blow off the water pipes every month or so. It happened that during the time the 48 hour interruption in service is alleged to have

occurred by the complainant Beck, that this attendant opened up the blow-off at the hospital and entirely forget to close it, resulting in the emptying of the reservoir seven miles distant. It is not likely that he will do this again, but of course it is possible.

Edward Hoffnagle, Postmaster of Penbrook Borough, stated when asked, that the water service in Penbrook is excellent in the main and the public has no reason to complain, so far as he knows.

Because the original Progress Water Company and the original Penbrook Water Company fixed in their franchise a minimum meter rate of \$8. per annum and 30 cents per thousand gallons with a flat rate of \$6. for single spigot, the Susquehanna Township Water Company and the Extension Water Company of Penbrook now maintain these rates, although they are lower than the rates charged by the Paxtang Consolidated Water Company, the Rutherford Heights Water Supply Company or the Hummelstown Consolidated Water Company.

Fire service is afforded in Penbrook. At the hospital the charge for water is 4 cents per thousand gallons.

In the village of Progress, Susquehanna Township, at Hotel Progress, the man interviewed reported that the service was good but that there was some complaint about air in the water. This is due to the service main being a dead end. Possibly the air valves do not work to the best advantage. The company uses the hydrants along the streets with which to blow off the air when there is undue complaint.

Mr. Beck's principal complaint is that the company shuts off water without due warning to the consumers; also that there is no local agent of the company nor is the office of the company open at night so that in case of suspension of service, the consumers have nowhere to go for information or to whom an accident or break can be reported until the next morning; that during office hours, the company's agents in charge at the office in the Commonwealth Trust Building, Harrisburg, oft times give facetious answers or misleading information to 'phone inquiries.

The complainants Beck, Lumb, Smith and Hetrick, whose houses are on the highway in the rear of which is the public park and golf course, most earnestly covet and desire the City of Harrisburg water, which extends practically to their back doors. It is significant that nowhere else throughout the very extensive district of the operating company has there developed or could be found remonstrance to the service rendered, but to the contrary, the service is commended.

Conclusions.

1. That the water company only shall operate the blow-off at the State Hospital.

2. That the water company shall not supply to the P. & R. Railroad at any time a volume of water in excess of that which can be supplied and at the same time maintain a continuous and satisfactory service in the water district beyond.

3. Mr. Wagoner & Son, Plumbers, of Penbrook Borough, are the local representatives of the company in that neighborhood, so it is stated by C. E. Schaup, Engineer of the Paxtang Consolidated Water Company; but it appears that the consumers do not understand this. The company should maintain locally, after establishing either at the office of the said Wagoner & Son, or elsewhere, a company 'phone, a satisfactory information bureau for the benefit of the consumers there not only during the day time but for emergencies at night. Furthermore, the department of the company's agents in the general office at the Commonwealth Trust Building should be such with respect to answer to consumers, whose service is interrupted, as to obviate any basis for complaint as to inattention and lack of courteous treatment. All complaints of a local nature should be properly made to the company and the company must be bound to properly act on such complaint.

4. The water company should be careful to notify its consumers of any intended and necessary interruptions in the service, or in case of accident, to promptly inform the consumers affected of the nature thereof and the probable extent of the interruption in the service.

5. The air valves on the distributing system should be examined frequently and be kept in working condition. If it be feasible at the end of the pipe from which the complainant draws the water, for a connection to be made with the City of Harrisburg water works system, so as to temporarily feed city water into this portion of the company's pipe line during such times as a temporary interruption in the company's service may occur. This should be done.

7. JACKS.

In the operation of electric railways—urban and suburban—derailments and more serious accidents in which other vehicles or human beings become lodged under the car are bound to occur from time to time. If the accident is a derailment, it is essential in the interest of good service to get the car back on the track as quickly as possible. If it happens that an unfortunate human has become jammed under the car or the car wheels, his rapid removal from the position will enable him to receive so much sooner the proper medical

aid that may reduce very much the seriousness of the injury, or that may even mean the difference between a serious and a fatal occurrence. In response to a rapidly crystalizing public sentiment in favor of some measure that would ensure prompter and more effective measures, particularly in accident cases involving injury to life and limb, the Public Service Commission held a hearing on May 7th, 1914, at which hearing interested parties were invited to present their views. On May 21st, 1914, the Commission issued General Order No. 10, calling for the equipment of all street railway cars with suitable jacks.

THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA.

At a meeting of The Public Service Commission of the Commonwealth of Pennsylvania, held at its office in the City of Harrisburg, Pennsylvania, on the twenty-first day of May, 1914.

PRESENT:

S. LA RUE TONE,
 SAMUEL W. PENNYPACKER,
 EMORY R. JOHNSON,
 MILTON J. BRECHT,
 CHARLES F. WRIGHT,
 FRANK M. WALLACE, Acting Chairman,
Commissioners.

GENERAL ORDER NO 10.

In the matter of installing Jacks on the Cars of Street Railway Companies:

AND NOW, May 21st, 1914, it is ordered that each street railway car, engaged daily in operating service upon the surface of streets and highways within this State, be equipped with a jack of a lifting capacity sufficient to raise one-quarter of the total weight of a double truck car and one-half of the total weight of a single truck car at least eight inches.

It is further ordered that one-half of the cars of each street railway company be equipped in the manner as above described on or before December 1st, 1914, and that every car included in the provisions of this order be equipped on or before June 1st, 1915.

BY THE COMMISSION:

A. B. MILLAR,
Secretary.

The investigation of the question by the Chief of the Engineering Bureau and the testimony presented at the hearing developed information that should prove of general value and interest, and hence is included in this report.

Some of the street railway officials present at the hearing expressed the opinion that the demand for jacks on each car was based more largely on sentimental than on practical considerations and that the effectiveness of a single jack in the hands of untrained and partly trained men in conserving life or reducing the severity of injury to the victim was open to doubt. They recognized the growth of public demand in the matter, believed it would be wise to yield to the demand, and were also anxious to co-operate with the Commission in improving service and general conditions. The representatives of the traction interests in Philadelphia considered their system of nine emergency districts and twenty-eight emergency vehicles, a system that enables them to place a vehicle carrying a complete outfit of wrecking equipment and a crew of trained men at the scene of an accident in the central sections of their system in from three to five minutes, as offering much more positive and effective relief. The question of jacks had been taken up with them by the Civic Club, an organization of women, and they had made an exhaustive study of the question in relation to their equipment, resulting in the design of a special jack which they considered very satisfactory.

A general discussion concerning the approval of certain makes and types of jacks by the Commission led to the conclusion that specification of the lift and of the lifting capacity in terms of the weight of the car to be handled was the rational solution of the problem. The action of the Commission was in accord with this thought. The character of the equipment and the nature of the roadbed would naturally affect the type of jack selected in any particular case. In Philadelphia, for example, the near side cars are equipped with a rubber sheathed board placed just before the truck to act as a secondary fender, making it necessary to develop a special form of jack that would enable a grip to be obtained upon the truck frame. It is also obvious that the conditions on a suburban road equipped with a "T" rail might require a different form of jack and a slightly higher lift than would be required for use on girder rail construction in paved streets.

The first requirements of a suitable jack are effective lift and lifting capacity, combined with general features adapted to the character of the rolling stock and to the nature of the roadbed. The jack should possess flexibility of application in order to be usable in close quarters, without blocking if possible, a requirement that may be met by a movable jaw on a swivel head or its equivalent, and by a short working lever and a short working stroke. Furthermore, the construction of the jaw must meet any special requirements imposed by the construction of the truck or of the car. The jack should be simple in its construction and its operation, and

should give its lifting capacity with minimum requirements of force applied consistent with reasonable speeds of lifting. Lightness of construction consistent with a strength will increase ease of handling and also reduce the yearly charge for weight carried on the car. The jack that can be handled and worked by one man will surely be better suited to this work than will the jack requiring two men for its handling or its working. Strength and ruggedness of construction—although opposed to lightness—are necessary factors to be considered in the selection of a jack, as a jack must stand up under repeated use, and even under abuse, and must always be ready for service. It must be absolutely reliable. As lowering a load is often as important as raising it, the construction governing this function is worthy of careful study.

Accompanying Figures No. 1 and No. 2 show the application of jacks to the lifting of the end of a car and to the raising of a car truck respectively, and also illustrate the structural difference between geared jacks and jacks of the hydraulic type.

8. RAILROAD AND RAILWAY CROSSINGS.

A-1. IN GENERAL.

Up to the end of the fiscal year, the Engineering Bureau has examined and prepared reports on 171 railroad and railway crossings. 123 of these 171 crossings were required by the plans approved by the Commission to be carried over or under the railroad or railway—78 crossings being eliminated at grade and 45 grade crossings being avoided by new work. 47 grade crossings were approved, 10 of which involved street railways and public highways, one was a freight siding, one was a temporary grade crossing and 35 were permanent steam railroad crossings. One grade crossing asked for was denied and the petitioners concluded to give up the idea of any crossing whatsoever at the street in question.

The statement in tabular form is as follows:

Grade Crossings Approved:

Freight Siding,	1
Temporary,	1
Street Railway,	10
Steam Railroad,	35

Total grade crossings approved,

Grade Crossings Eliminated:

Existing crossing done away with,	78
Avoided by new work,	45
	<hr/>
Total grade crossings avoided,	123
Asked for and no kind of crossing approved,	1
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Total,	171
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In the following pages will be found a description of these crossings, excepting those in South Philadelphia, which may be found under the section of this report dealing with the improvements of the Port of Philadelphia.

A-2. PHILADELPHIA.

In Philadelphia very extensive work has been done in the years past in the matter of eliminating and avoiding grade crossings. Many of the problems were met and solved at a time when the requirements for safety were not as exacting as at the present time. It will appear in connection with Reed and 71st Streets and Glenwood and Warrington Avenues, that the Public Service Commission has had to be governed somewhat in its decision relative to the plans for avoiding grade crossings at these points by what has been done in the past.

a—Reed Street Foot Bridge—Philadelphia.

Over the Tracks of the Baltimore & Ohio Railroad.

Reed Street is in South Philadelphia. It extends from the Schuylkill River to the Delaware River. There is a small section of the land thoroughly built up south of Grays Ferry Avenue and lying between the Schuylkill River and the Baltimore & Ohio Railroad in which Reed Street is built up; but this section of Reed Street has not been physically connected with the section of Reed Street east of said B. & O. Railroad. The public traffic has never amounted to enough in this small west section to demand the building of a highway bridge over the railroad tracks at Reed Street but there is a demand and sufficient warrant for a bridge for pedestrians and such a structure the City now purposes to provide.

The Baltimore and Ohio Railroad connects with the Philadelphia and Reading Railway in the vicinity of Girard Avenue near North Philadelphia. For the purposes of this report the discussion will be confined to that portion of the line of the B. & O. from Market Street south. Beginning at Market Street, the B. & O. Railroad follows down the east bank of the Schuylkill River through the passenger station in the city block between Chestnut and Walnut streets, thence under South Street and under the Delaware Extension of the Pennsylvania Railroad, and thence by tunnel under Grays Ferry Avenue and P. B. & W. Railroad and under a highway bridge at Wharton Street, and thence passing Reed Street where as hereinbefore stated there is no physical crossing, and over the Schuylkill Avenue and the Schuylkill River

into West Philadelphia and thence in a southerly direction into Delaware County. Beginning at Reed Street and extending southerly along the east bank of the Schuylkill River are the freight and storage yards and extensive repair shops of the B. & O. Railroad. Along the line described from Market Street to the Delaware County Line, there are in the City 13 highway crossings, 3 railroad crossings and the proposed foot bridge crossing. A tabular statement with respect to these crossings follows:

Number.	Crossing.	Baltimore and Ohio Railroad passes under.		No. tracks bridged over.
		Overhead structure.	Vertical clearance.	
1	Market St.,	Deck girder,	Ft. 15.83	2
2	Chestnut St.,	Viaduct,	20.50	2
3	Walnut St.,	Viaduct,	20.17	6
4	South St.,	Steel Truss,	22.67	4
5	P. R. R. De. Ex. Br.,	Steel Truss,	18.23	4
6	Grays Ferry Ave.,	Tunnel,	17.25	2
7	P. B. & W. R. R.,	Tunnel,	17.25	2
8	Wharton St.,	Girder,	18.00	4
9	Reed St. (foot bridge),	Steel Truss,	20.5	8
10	Schuylkill Ave.,	(R. R. over), .....	.....	.....
11	Gibson Ave.,	Girder,	18.00	2
12	P. B. & W. R. R.,	Truss,	18.00	6
13	Grays Ave.,	(R. R. over), .....	.....	2
14	Woodland Ave.,	Girder,	17.21	4
15	61st St.,	Girder,	17.00	4
16	Cemetery Lane,	Wood, .....	.....	2
17	65th St.,	Girder,	18.4	2

It will be observed that only one of all the bridges given in the above table affords a clearance between the tracks and the bridges of over 20.5 feet, which is the head room proposed at the foot bridge. Furthermore, the clearance over rails at the proposed Reed Street foot bridge is to range from the minimum of 20.5 feet to the maximum of 21.8 feet, which clearance is satisfactory to the railroad company. The detail plans have been approved by the chief engineer of the railroad and by the proper city officials.

The bridge is to be 8 feet wide in the clear and to have a span of 174 feet. The estimated cost is \$12,500, all of which expenses is to be assumed by the city.

The plans were approved with this modification, namely that the vertical clearance should not be less than 21.8 feet. If greater clearances than those now provided along the line of the railroad and shown in the above table are ever required, it will necessitate extended changes in the railroad all along the line and the work would have to be done all at one time.

b—71st Street Bridge—Philadelphia.

Over the Tracks of the Philadelphia, Baltimore and Washington Railroad.

Seventy-first Street is in West Philadelphia and extends from Cobbs Creek—the Delaware County Line—in a general easterly direction to the marshes along the Schuylkill River.

The Philadelphia, Baltimore and Washington Railroad primarily started in South Philadelphia, at the corner of Broad Street and Washington Avenue, and extended westward across the Schuylkill River near Grays Ferry Avenue and thence in a southerly direction through West Philadelphia into Delaware County. Now, there is a branch line near Grays Ferry Avenue, (which branch line is the main line as the railroad is operated) that continues northerly along the west bank of the

Schuylkill River from near Grays Ferry Avenue to the station in West Philadelphia at Market Street. This connecting line comprises a part of the Central Division of the said P. B. & W. Railroad—a part of the Pennsylvania Railroad System.

On the P. B. & W. main line from West Philadelphia station to Cobbs Creek there are 18 public highway crossings in the city. A tabular statement with respect to these crossings named in order from the station follows:

Number.	Crossing.	Pennsylvania Railroad passes under.		No. tracks bridged over.
		Overhead structure.	Vertical clearance.	
1	Market St.,	Tunnel,	Ft. 13.92	2
2	Chestnut St.,	Tunnel,	13.92	
3	Walnut St.,	Viaduct,	24.58	
4	Walnut St. in yards,	Viaduct,	13.21	17
5	South St.,	Viaduct,	18.00	
6	Grays Ferry Ave.,	Viaduct,	19.69	
7	49th St.,	Steel girder,	19.50	6
8	49th St. in yards,	Steel girder,	18.00	
9	B. & O. R. R.,	Steel Truss,	18.00	
10	54th St.,	Steel girder,	24.30	6
11	58th St.,	Steel girder,	20.00	6
12	60th St.,	Steel girder,	18.08	4
13	62nd St.,	Steel girder,	20.08	4
14	63rd St.,	Steel girder, .....	.....	4
15	65th St.,	Steel girder,	19.84	4
16	67th St.,	Steel girder,	20.00	4
17	71st St.,	Steel girder,	18.70	4
18	72nd St.,	Steel girder,	19.45	4

It will be observed that there are a number of bridges over the Pennsylvania Railroad along the line under discussion which provide a vertical clearance from the lowest part of the bridge to the top of the rails of the tracks beneath of 18 feet or under.

For over a year, traffic across the 71st street highway bridge over the Pennsylvania Railroad has been discontinued owing to the unsafe condition of the structure. The proposed new bridge is to replace the old wooden one. The new bridge is to be a steel through-girder structure. The steel work is to be encased in concrete. The vertical head room between the tracks and the bridge above is to be 18.07 feet. The street approaches and the connecting streets are all established at grade, and on the west side of the railroad they are surfaced with brick or asphalt and the land is quite thoroughly occupied by dwellings. The approach from the west from Paschall Avenue is on a 4 per cent. grade ascending; and from the east beginning at Grays Avenue the grade ascends on a 3.83 per cent. grade. The existing abutments of the old bridge are in good condition and will be used for the new structure, as well as the existing piers. The foundations of the abutments and piers are so built as to provide in the future for four additional railroad tracks under the bridge.

It is feasible in case it becomes necessary, for any reason, to increase the existing vertical clearances at the several bridges hereinbefore mentioned, to lower the roadbed of the railroad. To gain increased headroom by elevating the highways would involve heavy damages to abutting property. Grades would have to be reestablished, permanent pavements and sidewalks would have to be changed, entrances to buildings would have to be altered and the public would be much more inconvenienced in this manner than by changes in the grade of the railroad.

The proposed bridge is of the design in general use by the City for similar crossings and it is approved by the Chief Engineer of the Railroad and the proper city officials.

The estimated cost and expense of the erection of the said bridge is \$24,000, all to be borne by the City.

The total width of the bridge is to be 63 feet and the total length between face of abutments, 122 feet. It would seem that practical considerations limit the clearance for the present to that proposed and that the way to get more headroom in the future will be to lower the railroad; but this will involve changes in the tracks at more than one crossing.

The plans were approved.

c—Glenwood Avenue Bridge—Philadelphia.

Over the Philadelphia and Reading Railway.

Glenwood Avenue is an important thoroughfare laid out to extend from East Park on the Schuylkill River, northerly parallel to and just east of the Pennsylvania Railroad—main line to New York—through North Philadelphia.

The Richmond Branch of the Philadelphia and Reading Railway begins at the terminal facilities of said railway company on the Delaware River at Port Richmond, in the 25th and 31st Wards and thence it extends northwesterly to near Wayne Junction and thence southwesterly to and crossing the Schuylkill River and thence northerly along the west bank of the river towards Reading. The line was constructed many years ago when the country through which it passes was sparsely settled. Now it has become thoroughly built up for most part. There are along said line in the City 28 crossings. Data regarding these crossings is given in the following tabular statement:

Number.	Crossing.	Philadelphia & Reading Railway.		No. tracks bridged over.
		Overhead structure.	Vertical clearance.	
1	City Line,	Viaduct, .....	.....	....
2	Norristown Br. P. & R. Ry.,	Truss,	23.88	3
3	Fox St.,	Arch,	*18.00	2
4	Stokley St.,	Girder,	16.00	2
5	Chestnut Hill Br. P. R. R.,	Steel,	22.79	4
6	Wissahickon Ave.,	Girder,	16.0	4
7	Blabon St.,	Foot bridge,	20.00	6
8	Germantown Br. P. & R. R.,	Steel,	17.58	4
9	Clarissa St.,	Girder,	16.00	4
10	Germantown Ave.,	Wooden,	18.00	2
11	Hunting Park Ave.,	Girder,	16.00	2
12	Broad St.,	Girder,	16.00	2
13	York Road,	Girder,	16.17	4
14	Erie Ave.,	Girder,	16.00	4
15	Venango St.,	Grade, .....	.....	.....
16	Rising Sun Ave.,	(R. R. over St.), .....	.....	.....
17	Tioga St.,	Grade, .....	.....	.....
18	Ontario St.,	(R. R. over St.), .....	.....	.....
19	Sedgley Ave.,	Girder,	16.00	3
20	Connecting Br. P. R. R.,	Steel,	16.65	4
21	Glenwood Ave.,	Girder,	16.00	4
22	6th & Allegheny,	Girder,	18.60	4
23	5th St.,	Girder,	18.00	4
24	N. Penn Br. P. & R. R.,	Truss,	15.67	8
25	Second St.,	Girder,	18.50	8
26	Front St.,	Girder,	15.20	4
27	Cambria St.,	(Proposed),	16.00	13
28	Somerset St.,	Truss,	16.66	7

*Outer rail.

All the other streets to the Delaware River pass under the railroad. Extensive abolition of grade crossings just completed through Kensington.

The territory all around the proposed crossing at Glenwood Avenue is thoroughly built up and occupied by factories and dwellings. Streets are paved at established grades and they are opened and in use up to the railroad location on both sides.

The proposed highway bridge is to be a steel through girder encased in concrete with a longitudinal span between the abutments of 56 feet and a width of 60 feet over all.

The plans have been approved by the chief engineer of the railway company and by the proper city officials. The estimated cost and expense of erecting the bridge is \$40,000, all to be borne by the city.

The proposed headroom of 16 feet, it will be noted by reference to the above table, is the same as that at 10 of the existing crossings. It would appear to be impracticable to increase this headroom at Glenwood Avenue by elevating the street higher than it is proposed to elevate it. The west approach as now planned involves no change in the grade of the street nor the buildings and pavements. This existing grade in Glenwood Avenue is 6 per cent. To carry the bridge higher than proposed will involve a large additional expense including damages to the property. Furthermore, when it shall appear to be necessary to obtain more than 16 foot headroom between the underside of the bridge and Glenwood Avenue and the top of the rail underneath, it will also have become necessary that more headroom than now exists shall be obtained at the other crossings hereinbefore enumerated. At all of the said crossings with an exception or two, and in the vicinity the property developments are complete and hence to change and elevate the established street grade with all that this means would not only involve an enormous outlay of money but it would be a positive detriment to the highway traffic. Besides, the elevation of the streets is unnecessary. The railroad tracks can be lowered no doubt at much less expense.

In view of the foregoing considerations, the abutments of the proposed Glenwood avenue bridge should be carried down deep enough to permit of the lowering of the railroad tracks.

The Richmond Branch was built years before the expansion of the City made the present number of crossings necessary. From somewhere near Germantown Avenue, where the summit of the railroad is, the grade to the Delaware River is uniform and 0.66 per cent. On this grade it is possible for a locomotive to draw from the river up to the summit a train of as many light cars as a locomotive will handle heavily loaded cars on the down grade to the river. Hence the company will not readily assent to a change in this grade and it will probably be some time before either the city or the railway company will raise the issue before the Public Service Commission as to a safe headroom for bridges over the tracks along this line.

d—Warrington Avenue Foot Bridge, Philadelphia.

Over the Philadelphia and Baltimore Central Railroad—Pennsylvania Railroad System.

Warrington Avenue is in West Philadelphia and extends from Cobbs Creek northerly to Baltimore Avenue.

The Philadelphia and Baltimore Central Railroad begins, for the purpose of this report, at the West Philadelphia passenger station on Market street, extends southerly along the west bank of the Schuylkill River to near Grays Ferry Avenue, where it deflects to the west and extends across the city and out into Delaware County, passing there through Yeadon and Lansdowne Boroughs on its way to Baltimore.

The part of this railroad extending from West Philadelphia to near Grays Ferry Avenue is along the main line of the Pennsylvania Railroad system from Philadelphia to Washington. From this passenger station to Cobbs Creek, along the Central Railroad Branch, there are 17 crossings in the City. A tabular statement with respect to these crossings and clearances follows:

Number.	Crossing.	Pennsylvania Railroad passes under.		No. tracks bridged over.
		Overhead structure.	Vertical clearance.	
1	Market St.,	Tunnel,	13.92	2
2	Chestnut St.,	Tunnel,	13.92	2
3	Walnut St.,	Viaduct,	24.88	2
4	Walnut in yards,	Viaduct,	15.21	2
5	South St.,	Viaduct,	18.00	2
6	47th St.,	Girder,	16.35	2
7	Woodland Ave.,	Girder,	16.75	2
8	Kingsessing Ave.,	Foot bridge,	16.00	2
9	49th St.,	Girder,	16.25	2
10	Chester Ave.,	(R. R. over St.),	16.25	2
11	Springfield Ave.,	Foot bridge,	17.00	2
12	Warrington Ave.,	Girder,	*16.00	2
13	52nd St.,	Concrete arch,	(R. R. over St.),	2
14	Thomas Ave.,	Steel,	20.00	2
15	55th Ave.,	Concrete arch,	*16.00	2
16	57th St.,			
17	53th St.,			

*Outer rail.

It will be observed that there are 7 bridges with a head room of 16.25 feet or less, and that the head room at all of the bridges, with one exception, along the Central Division, is below standard.

Warrington Avenue is paved and grades permanently established. The land is all occupied by dwellings and these developments have been improved with respect to street grades and house lot elevations, in conformity with an agreement between the city and the Railroad Company, signed in 1894, the Railroad Company then agreeing to lower its tracks whenever more clearance shall be needed than existed at bridges over the railroad at that time and as shown in the above table.

At Warrington Avenue the amount of this proposed lowering is 4.5 feet. Therefore, while the present proposed head room is to be 16.25 feet only, the ultimate clearance will be 20.75 feet.

At and along most all of the crossings the property in the vicinity thereof has been improved by the erection of buildings and the permanent paving of the streets. The span of the bridges between abutments provides ultimately for 4 parallel tracks. To increase the vertical clearance by raising the street grades would very extensively inconvenience the public by changing established conditions under which improvements were made and by increasing the steepness of the approaches to the bridges over the railroad, thus putting for all time a burden on the highway traffic. This is not necessary because it is practicable by the lowering of the railroad, at less cost than to change the highway grades, to increase the head room to the neighborhood of 20 feet as originally contemplated in the said agreement of July 18, 1894.

The proposed foot bridge at Warrington Avenue is approved by the chief engineer of the railroad and the proper city officials. The estimated cost of the bridge is \$6,000, and the cost of damages to property \$2,000, all of which is to be assumed by the City. The width of the foot bridge is to be 6 feet and its total span 62 feet. The steps and landings are arranged in such a way that it is not practicable at this time with the use of the ordinary riser to obtain a greater height of the bridge above the tracks and keep the landings on the sidewalks.

The plans were approved.

The increasing of vertical clearance along this line of railroad in Philadelphia will be a problem in itself sometime and whatever changes are decided upon they will naturally be done as a single piece of work.

e—Delaware Avenue Grade Crossing, at Pier No. 40, Philadelphia.

The City of Philadelphia is erecting Pier No. 40, South Wharves from the bulk head line at Delaware Avenue to the pier head line; this is near Queen Street. Delaware Avenue is the thoroughfare which parallels the Delaware River, and by means of which all traffic is carried to and from the docks, wharves and piers located on said river for the greater portion of its length in the city. On the easterly side of this thoroughfare are the said wharves, etc., and on the westerly side are warehouses and places of business such as may be found along the water front of a great sea port. In the middle of the thoroughfare running lengthwise thereof are the tracks of the Delaware Extension of the Pennsylvania Railroad Company. This company constructed the tracks and operates the same under an agreement with the Philadelphia Belt Line Railroad Company (a quasi municipal railroad) to handle the latter's traffic and that of all other traffic consigned through the said belt line. This belt line right of way begins northerly at the Point Richmond freight yards and tracks of the Reading Railway Company, and it extends southerly in Delaware Avenue and along the lower part at considerable distance south of Queen Street. There are approximately 200 sidings from said Pennsylvania Railroad tracks into the wharves, docks and piers and the said warehouses, etc. These sidings are all necessary, and ultimately the street traffic may become so congested that Delaware Avenue may have to be widened or the railroads elevated, or some other arrangement therefor to provide for public necessities on the thoroughfare. However for the present it is impracticable on account of the expense involved to offer other than sidings which must cross the avenue at grade from railroad tracks in the centre.

Pier No. 40 must have a connection with the said railroads in order to accommodate the business for which the pier is constructed. The Public Service Commission approved the proposed siding at grade into the pier.

f—Westmoreland Street Crossing, Philadelphia.

The Philadelphia and Trenton Branch of the Pennsylvania Railroad is the one involved in this petition. It starts at Kensington Station in the 19th ward and extends northerly to Tioga Street freight station in the 45th ward; thence it continues northerly to Frankford, connecting here with what is known as the main line to Trenton and New York.

The Tioga freight station is east of the railroad and on Witte Street (which is parallel to and 200 feet from the said railroad) the freight yards lying between Westmoreland Street on the south and Ontario Street on the north. The three main running tracks of the railroad are elevated and carried over said Ontario and Westmoreland Streets and over Willard Street beyond by suitable and permanent steel bridges, the tracks in between being supported on earthen embankment.

It is proposed by the railroad company to build another siding at grade across Westmoreland Street immediately east of the bridge abutments, this siding to be a spur from the main siding which now comes down from the railroad into Westmoreland Street; thence the new siding is to continue southerly along the foot of the earth embankment of the main railroad and on land of the railroad company to Willard Street and across Willard Street at grade to and onto land of William E. Cooper, one of the petitioners.

Willard Street is not opened and paved under the railroad and beyond to Witte Street and up Witte Street to Westmoreland, or if opened the streets are not improved; but they will be no doubt most anytime.

The city has by ordinance, approved on the 31st day of December, 1913, authorized the railroad company to lay and maintain the said siding across Westmoreland and Willard Streets. There is a provision in said ordinance as follows:

"PROVIDED, That said siding be removed at any time upon the passage by councils of an ordinance to that effect without any recourse against the City of Philadelphia for damages, either property, personal or otherwise."

The Public Service Commission withheld approval of the proposed siding.

A-3—CROSSINGS OF THE PITTSBURGH, BESSEMER AND LAKE ERIE RAILROAD AND PUBLIC HIGHWAYS IN ALLEGHENY AND BUTLER COUNTIES.

The said Pittsburgh, Bessemer and Lake Erie Railroad is straightening and otherwise improving its main line in West Deer Township, Allegheny County, and in Clinton Township, Butler County. In connection with the changes incident to the work, an agreement has been reached between the said Company and Clinton Township, and between the said Company and West Deer Township.

a—Culmerville Road Crossing, West Deer Township.

The Culmerville-Butler Road is a public highway passing southerly up the valley of a small tributary of Bull Creek to Culmerville Village. This portion is a section only of the through highway from Butler on the north to the towns along the Allegheny River on the south.

Just north of Culmerville the said line of this railroad is to be deflected to the right, and a new road bed will be constructed for a distance of about a mile and a half. Where the new line begins to deflect, there is at present a crossing under the railroad of the said public highway, which highway then deflects to the west and follows closely the railroad northerly. It becomes necessary, according to the plan for the new railroad, to cross the said highway at a point about 600 feet northerly of the existing under pass. In other words, it is proposed that the new highway shall parallel the railroad as reconstructed, and be west of it for several miles, with the exception of a length not exceeding 1,000 feet where the highway will cross under the railroad to the other side by a new under pass, and thence back again to the west side by the existing under pass.

The Railroad Company is planning to construct a proposed new crossing for a four-track 60 foot steel girder span bridge of the deck type. The highway underneath will have a width of 26 feet and a vertical clearance of 14 feet. At present two tracks only will be built. In carrying out this plan, it is necessary that the highway should be moved over to the east, and this change the railroad company will make.

b—Millerstown Crossing, West Deer Township.

As previously stated, on the main line of the Pittsburgh, Bessemer and Lake Erie Railroad, in West Deer Township, and extending over into Clinton Township, Butler County, there are changes in alignment, and other improvements being made for a distance of a mile. New tracks are being carried to the east of the old tracks, and it is necessary to cross the old highway known as Millerstown Road, which connects the Kittanning Road on the west and the Tarentum Road on the east. This connecting highway is about one-half mile long. Instead of crossing the grade, the Railroad Company proposes to pass over this highway, and to change its location, moving the public road further north, and shortening and straightening the length of said road.

The proposed bridge supporting the railroad over the Millerstown Road is to be a masonry arch structure 26 feet horizontal clearance and 16 feet vertical clearance at point on 6 feet on either side of the centre of the roadway. The entire length of the barrel of the arch will be 310 feet. The highway approaches and the arch will be in the same line.

c—Public Highway Grade Crossing, Clinton Township.

Where the said main line of the Pittsburgh, Bessemer and Lake Erie Railroad in Clinton Township crosses the public highway extending from Butler to Culmerville (via Saxonburg) there is at present an oblique crossing at grade of the said public highway of the existing railroad tracks. It happens that near this crossing the proposed straightening of the railroad will begin, which makes necessary the moving over of the railroad tracks at the highway of 25 feet or more to the west, and the Railroad Company also proposes to lay two tracks across the highway, where one is now laid. The change in the location of the public road does not involve an alteration of the grades of the highway. It consists simply in shifting the position of the highway at that place so that the crossing will be more perpendicular than it is at the present time. The township supervisors have agreed to this plan.

d—Summit Road Crossing, West Deer Township.

The said Railroad Company is extending a branch line westward for about three miles to Mine No. 3 of the Ford Collieries Company. This line crosses Summit Road. The township supervisors have agreed that the Railroad Company may construct the railroad at Summit Road below grade, the plan providing for a girder bridge to sustain highway traffic of 100 pounds per square foot, equivalent to a load produced by a 15 ton roller. Twenty-two feet beneath the under part of the girder will be placed the top of the rails of the proposed track. The railroad is to be constructed in excavation here. Thirty feet on either side of the track centre is to be built concrete piers that will be carried up a sufficient width to support the main girder in position. This part of the highway bridge will be a through girder construction. On either side beyond these piers a 25 foot girder will be provided, one end resting on the pier and the other end on the timber abutment. The roadway of the bridge will be 24 feet wide. The 25 foot spans will be deck girder construction. The roadway surface on the bridge will have a grade of 2.4 per cent.

e—Church Road Crossing, West Deer Township.

Along the line of said branch railroad, and about one-third of a mile distant from Mine No. 3 of the Ford Collieries Company there is a public highway known as Church Road. The proposed railroad will pass under this highway in a cut. The railroad company and the supervisors of the township have agreed upon the plan. This plan provides for a through girder bridge 60 foot span, twenty-four foot roadway, the girders to be supported by concrete piers. On either side of the piers the bridge is to consist of a deck girder construction 30 foot span, making the total length of the bridge 120 feet. The outer end of the 30 foot girders are to rest on the timber abutments, this construction being adopted to permit of adjustment as the fill on the embankments settled. The final abutments will be of concrete construction. The north approach to the bridge for 230 feet in length is to be on an 8 per cent. grade, terminating in an existing 8 per cent. descending grade. The southerly approach is to be level instead of the existing 8 per cent. descending grade. The top of the rails of the tracks will be 22 feet below the lowest part of the highway bridge.

The Railroad Company will provide a temporary crossing while the highway construction is being carried on. The railroad company will keep the bridge in repair, and in the event of the abandonment of the crossing, it will restore the crossing to the township.

f—Batz Road Crossing, West Deer Township.

At Mine No. 3 of the Ford Collieries Company there is a highway known as Batz Road. This highway will have to be crossed by the branch line of the railroad, but it is proposed to make this crossing a temporary one. The railroad tracks are to be supported on the temporary trestle on either side of the highway, and by a deck girder bridge of 25 foot span over the highway, giving a vertical clearance of 15 feet or more for highway traffic beneath.

The railroad company and the supervisors of the township have agreed upon the plan, which provides for the laying out of the new Batz Road south of and parallel to and on the land of the Ford Collieries Company to connect with the Church Road, which is completed, it is proposed to abandon the old Batz Road (all on the Ford Collieries land) the portion to be closed amounting to about 3000 feet in length. The railroad company will then fill in underneath its tracks, and the crossing will be abandoned.

The grades on the new Batz Road will be no steeper than on the old Batz Road, but the new road will add materially to the vertical height to which all loads must be raised on the highway, but this is agreed to by the township supervisors.

g—County Road Crossing, West Deer Township.

The Bessemer and Lake Erie Railroad Company proposes to connect its branch line, operating over the grade of the Dorserville and Culmersville Road, and the plan has been agreed to by the county and railroad authorities. It provides for a widening trestle about 500 feet long for temporary construction. The alignment of the trestle is upon a 3° curve. The railroad will be carried over the county highway about midway of this trestle by a steel bridge. The abutments are to be of concrete masonry and the bridge of the steel girder type with at least 26 foot horizontal clearance between the abutments, and a vertical clearance of 16 feet

between the surface of the improved highway and the bottom of the steel girders. The highway between the abutments is to be improved for the full width of 26 feet. To protect the traveling public the railroad agreed to construct a suitable floor to the said overhead bridge, this floor to extend for a distance of 7 feet on either side of the centre line of the proposed track.

These several plans for crossings were approved by the Public Service Commission subject to certain conditions which appear elsewhere in the annual report of the Commission.

A-4. MISCELLANEOUS.

Certain crossings may be classed as miscellaneous including 10 crossings at grade of public ways and a street railway. They are described under this heading.

a—Hanover Township Grade Crossing.

The Delaware, Lackawanna and Western Railroad operate extensively in Luzerne County. The main tracks of this company are opposite Hanover Township, in Plymouth Borough and Plymouth Township. The company has a bridge over the Susquehanna River from these two places, and across this bridge there is a branch line extending southerly in Hanover Township with a switch to the Bliss mine of the Truesdale Colliery; also another branch to the Auchincloss mine. These two branches now cross at grade a township highway known as the Dundee Crossway. Owing to certain developments in the vicinity, it has become desirable and necessary to cross in two other places the said public road. Instead of attempting to establish these two additional grade crossings the company proposes to bring about an abandonment of a portion of the said public road and the substitution therefor of a new highway which shall pass under the two branches hereinbefore named. The plans for this change have been approved by the Hanover Township Commissioners, and an agreement has been entered into between the said township commissioners and the railroad company providing for the construction and maintenance of the new highway and two under passes. The railroad company will make all the changes at its own cost. Thereafter, the township will maintain the highway and the company will maintain the bridge.

One of the proposed under passes is now in existence. It comprises a stone arch culvert carrying the Auchincloss branch over Black Creek, sometimes called Nanticoke or Sugar Creek. The culvert has a radius of 16 feet and a vertical height at the crown above the bed of the stream of approximately 23 feet. It is proposed to build a concrete culvert in the bed of this stream. It will be a box shaped culvert with two compartments each 11 feet wide by 5 feet 7½ inches high. The top of this culvert will be reinforced concrete, and it will afford the roadway surface with a new highway, which is to occupy the space above under the arch. There will be a vertical clearance of 14 feet for a height of 20 feet from the middle of the arch.

Adjacent to the culvert there is a concrete arch constructed to carry the proposed branch from the Auchincross breaker to the Dundee Shaft in the vicinity over the creek and the new highway. The construction for the water way will be the same as described in the preceding paragraph, and above this water way at the crown there will be 19 feet head room. The radius of the arch is to be 12 feet. The box culvert will be constructed under stream for a distance of about 100 feet and a new channel will be constructed for the creek several hundred feet in length to assure drainage of the culvert. The only thing that could happen in the event of some extraordinary rainfall, overtaking the capacity of the culvert, would be an overflow temporarily, and the passage of the water over the box culvert and down the roadway through the arches to the street below.

On the Bliss Branch a new under pass is to be constructed. The railroad is to be carried over the highway on a plate girder construction, resting on concrete abutments, and providing for vertical clearance of 14 feet, and a horizontal clearance of 24 feet. There will be no pocket at this under pass, the grade of the highway affording sufficient grade for surface drainage.

The plans were approved by the Public Service Commission subject to certain conditions appearing elsewhere in the annual report of the Commission.

b—Grade Crossing, Hatfield Borough.

The Philadelphia and Reading Railway Company's petition states that the proposed crossing is in Hatfield Township. It has later developed that the public road to be crossed, known as Union Avenue, is in the Borough of Hatfield rather than in the Township of Hatfield.

Union Avenue is a public highway in the northern part of said borough having a width of about 2.5 rods, a nearly level grade and being quite well built up in this vicinity of the double tracks of the P. & R. Railway which the highway crosses at grade. Union Avenue crosses said tracks nearly perpendicularly and at a point 150 feet, or thereabouts, distant from the railroad it turns and extends southerly through the borough paralleling the railroad tracks. West of the railroad there is a road running northerly out into the country and between this road and the angle in Union Avenue to the west there are three dwellings with a brick and stone sidewalk in front. The highway has a macadam surface. Along that portion of the avenue paralleling the railroad a dwelling occupies every lot.

East of the railroad and 150 feet therefrom in Maple Avenue beginning at Union Avenue and extending southerly—it is on the lot between Maple Avenue and the railroad that the North Penn Washer Company has erected a brick building and arranged for a siding to the plant. Along the south side of Union Avenue, beyond Maple Avenue, there are several dwellings.

The crossing at grade of the highway and the railroad is now protected by a sign, an electric light and a track circuit bell, which announces the approach of every train.

One-quarter of a mile south is the Hatfield passenger station and a highway grade crossing of the railroad tracks. Hatfield Borough is a community of about 700 inhabitants. The grade of the railroad would have to be changed for long distances north and south to obviate the existing grade crossings mentioned. The one at the station is not protected by gates. It is reported that the citizens have requested the railroad company to provide and operate a gate at this crossing and that the borough council will withhold any approval of the proposed siding across Union Avenue at grade until gates are provided at the station highway. However, this is considered an immaterial point.

The North Penn Washer Company is ready for the siding. The switch and material is on the ground ready for the work. There is no way to avoid this grade crossing without abolishing the existing grade crossing of the main tracks.

The Commission approved the grade crossing.

c—Manatawny Railroad Bridge Over Pennsylvania and Reading Railroads near Stowe, Montgomery County.

The said Manatawny Railroad has a connection with and begins at the Pennsylvania Railroad near Stowe in Montgomery County, and thence extends northerly along and parallel to the said single track of the Pennsylvania Railroad, crossing the State highway at Stowe station at grade and also crossing a public highway known as Grosstown Road at grade. Thence on an embankment newly built and

at an ascending grade and over Dasher Run on a wooden trestle to a point about 2,000 feet distant from the beginning where the line of the railroad crosses obliquely, and on a curve, the existing three tracks of the Philadelphia and Reading Railroad. The single track of the Manatawney Railroad is to be carried over the said tracks by a steel truss bridge having a vertical clearance above the top of the rails beneath of 22 feet and a span of 120 feet between the abutments. This span provides for three additional tracks in the future in the location of the Philadelphia and Reading Railroad.

This bridge was approved by The Public Service Commission.

d—Deodate and Hershey Railway Crossing.

The Hershey Transit Company now operates an electric street railway in and out of Hershey Village, Derry Township, Dauphin County. One of the lines of this company extends southerly out of the village to the Campbelltown Turnpike and thence easterly in said turnpike. It is proposed to construct a new line to be known as the Elizabethtown Line of the Hershey Transit Company, from the said Campbelltown Turnpike southerly through Dauphin County and Lancaster County to the Borough of Elizabethtown.

The street railway herein described is to be constructed by the Deodate and Hershey Street Railway Company. It is to begin at a point in Conewago Township in the public road from Elizabethtown to Hockersville, where the public road from Campbelltown meets said road, north to the village of Deodate, at or near Shanks Church, at which point ends the proposed Elizabethtown and Deodate Street Railway, from whence the said Deodate and Hershey Street Railway is to be built northerly in Conewago and Derry townships, Dauphin County, to a point in Derry Township on a public road formerly known as the Downingtown, Ephrata and Harrisburg Turnpike, or Campbellstown Turnpike, where the old Hummels-town and Campbelltown Street Railway tracks are now laid and operated by the Hershey Transit Company.

In this distance of about 3.5 miles, 2 public highways are crossed at grade in Conewago Township, Dauphin County, and 3 public highways are crossed at grade in Derry Township, Dauphin County.

The petitioner holds to the view that no safety devices, safeguards, or other protective means are required to be installed for the safety of the public at the proposed grade crossings.

It is true that the country through which the proposed railroad is to pass is a sparsely settled and entirely rural district. There is little use made of the highway except as the resident farmers pass to and fro thereon. The method of operation over the said crossings at grade will be the usual and ordinary operation of street railways in suburban communities, stopping at road crossings and other convenient stations to receive and discharge passengers, to receive and deliver packages, milk shipments, farm products and supplies, merchandise and other light freight and property. But since the tracks will not extend along a highway where they may be seen and avoided but will cross the highways perpendicularly and thus the pedestrian or driver of a vehicle may be taken unawares at the highway crossings, it seems reasonable and in the interest of public safety that the railroad company be required to put up signs indicating the location of the crossings, and that the crossings should be constructed and maintained with respect to the grades of the highway, surface drainage, etc., in an entirely safe and satisfactory manner.

They were all approved, subject to certain conditions relating to the manner of construction of crossings and the maintenance of warning signs.

e—Elizabethtown and Deodate Railway Crossings.

Mr. M. S. Hershey, the noted chocolate manufacturer, whose plant is located at the Village of Hershey, in Derry Township, Dauphin County, has built and is operating more than one electric street railway line out of said village into the surrounding country. The Hershey Transit Company now operates a line southerly out of the village to the Campbelltown Turnpike and thence easterly in said turnpike. It is proposed to construct a new line from this turnpike southerly through Dauphin County and in Lancaster County to the borough of Elizabethtown.

The street railway herein described is to be constructed by the Elizabethtown and Deodate Street Railway Company. It is to begin at the public square in the Borough of Elizabethtown, Lancaster County and at or near the Elizabethtown station on the Pennsylvania Railroad and thence from this point and the present terminus of the Elizabethtown and Florin Street Railway, northerly along High Street in said borough and out into and through Mt. Joy Township, Lancaster County, and in Conewago Township, Dauphin County, to the public road from Elizabethtown to Hockersville north of the village of Deodate at or near Shanks Church.

In this distance of about 6 miles 2 public highways are crossed at grade in Mt. Joy Township, Lancaster County, and 3 public highways in Conewago Township, Dauphin County.

The Public Service Commission approved these crossings subject to conditions relative to the manner of construction and maintenance.

A-5. VIADUCTS.

The plans for several viaducts received the attention of the Bureau and the Commission. They are described in this section.

a—Butler Viaduct, Butler Borough.

Involving the consideration of the elimination of crossings at grade of highways and railroad tracks throughout Butler Borough, Butler County, Penna.

General Conditions.

Briefly, the Borough of Butler is a thriving, industrial community of over 20,000 population. Surrounding it is the township of Butler, which has a population of 6,000, most of which clusters about and composes the environs of Butler Borough. In 1900, the population of said Borough and Township was less than one-half of what it is to-day. This boom is attributable to the new industries which have located in the town. The Standard Steel Car Company has an extensive plant in the southeastern corner of the Borough extending out into the township along the creek into the village known as Lyndora.

Besides being the county seat, Butler Borough is also in the centre of a farming region and also in the natural gas and oil fields.

The entire settlement stretches along the Connoquenessing Creek. The section on the south side is the newer part. Connoquenessing Creek rises a few miles to the north in Butler County, and follows a general southwesterly course, entering the Beaver River near Ellwood City, 32 miles distant. The valley of this creek in places is quite narrow and deep. Throughout Butler Borough it broadens out a little but the slopes are quite precipitous.

The Borough is a hilly town. Down this valley and through the Borough are the tracks of the Pittsburgh, Bessemer and Lake Erie Railroad and the tracks of the Baltimore and Ohio Railroad. The West Penn Division of the Pennsylvania Railroad has a terminal station in Butler, and the Buffalo, Rochester and Pittsburgh Railroad runs its trains over the tracks used by the Baltimore and Ohio.

Street and Railroad Crossings.

Following the course of the Connoquenessing Creek down through Butler Borough, the crossing of streets and railroads are as follows:

Millerstown Road,
Kittanning Street,
Lookout Avenue,
Centre Avenue,
South Main Street,
Road to Lyndora.

Millerstown Road, or East Jefferson Street Extension, sometimes known as Kearns Road, leads into Butler from the northeast. The crossing is at grade (in Butler Township) with the road bed of the Bessemer and Lake Erie.

Five thousand four hundred feet distant from the Kearns Road Crossing, in the Borough of Butler is the crossing at grade of Kittanning Road on the Bessemer and Lake Erie tracks and the tracks of the Baltimore and Ohio Railroad. Thus far the said road beds lie to the west and north of the Connoquenessing Creek.

One thousand feet distant in the Borough Lookout Avenue crosses at grade the tracks of the West Penn Division of the Pennsylvania Railroad, the station being located on this street, at the corner of East Jefferson Street. Thence passing southerly Lookout Avenue bridges the creek and near the south bank passes under the Bessemer and Lake Erie tracks and over the tracks of the Baltimore and Ohio Railroad, both of these railroads lying south of the creek, the bridges over the stream being located between the Kittanning Road and Lookout Avenue crossings. The B. & O. roadbed is in a cut here and the P. B. & L. road a high embankment.

One thousand five hundred feet farther southwesterly, Centre Avenue, the main thoroughfare of Butler Borough, crosses at grade the tracks of both said railroads, but the valley being narrow here has required the construction of the tracks of P. B. & L. E. along the north bank of the creek at this crossing and the construction of the B. & O. tracks along the south bank, the passenger stations of these two companies being located on Centre Avenue. Both the highway bridge and the railroad bridge spanning the creek are sufficiently high to be above floods, but it would not do to lower this head room very much.

One thousand feet down stream South Main Street crosses at grade the tracks of said railroads and necessarily spans the creek, the railroads being located on either bank of the stream. The valley is narrow at this point also and the street grades are precipitous here as at Centre Avenue. Main Street, however, is not built up as thoroughly as is Centre Avenue, the road surface is unpaved and the highway bridge at the creek is a wooden structure condemned as unsafe.

One mile westerly at the extreme end of the Borough where the Standard Steel Car plant is located, partly in and partly outside of Butler, and the Village of Lyndora is located there is a crossing at grade of Pierce Avenue and the tracks of said railroads.

Between the South Main Street Crossing and Pierce Avenue crossing, the **tracks** of the Pittsburgh and Butler Street Railway are carried over the tracks of the said railroads at a private right-of-way belonging to the said Street Railway Company.

At Pierce Avenue, the P. B. & L. E. tracks and a number of parallel switches are located along the north bank of the creek. The extensive plant of the Standard Steel Car Company and Lyndora Village are also on this side of the stream. The south bank of the Connoquenessing Creek here is precipitous. The B. & O. tracks are located on this slope and parallel to and adjoining the railroad location is the main public highway, known as the Three Degree Road. Back of this road there is a real estate development, which bids fair to become quite extensive.

Discussion of a Plan for Eliminating the Grade Crossings.

It is roughly estimated that to elevate the railroads, thus permitting the grades of the streets to remain unaltered, would cost approximately \$1,550,000, divided as follows:

B. & O. R. R.,	\$650,000
B. & L. E. R. R.,	800,000
P. & B. St. Ry.,	50,000
Lookout Avenue,	50,000
	<hr/>
	\$1,550,000
	<hr/>

To this estimate should be added the cost of adjusting the industrial tracks and Standard Steel Car Company's yards to the new grade, which has been estimated at a half a million dollars and also declared by said industrial company to be undesirable and impracticable.

This plan would disturb sidings and the existing railroad facilities to abutting properties. Furthermore, the project would have to be executed all at one time and the total cost would have to be imposed and laid upon the various interests concerned all at once. Lookout Avenue would have to be changed in grade at the B. & O. crossing; there would be attendant property damages there and the grade of the street would be permanently steeper.

By elevating the grade of the streets, permitting the existing grades of the railroad sidings, freight yards and industrial plants, and the passenger stations to remain unaltered, would cost approximately \$520,000, divided as follows:

Kearns Road,	\$80,000
Kittanning Road,	80,000
Centre Avenue, .....1050 feet long,	180,000
Main Street, 800 feet long,	100,000
Pierce Avenue, 700 feet long,	80,000
	<hr/>
	\$520,000
	<hr/>

By this plan there would still be a crossing at grade on Centre Avenue in order to maintain highway traffic to the passenger stations and freight yards and abutting properties along Centre Avenue.

To eliminate this crossing would impose an additional expense for damages and new construction work of approximately \$100,000.

The advantages of this plan are, first, that the changes need not be undertaken all at one time. Centre Avenue viaduct as proposed can be constructed now, the money having been provided by vote of the electors of the Borough. The Main Street crossing can be abolished at some later period when the citizens of the Borough demand it, and so on. By this plan the present grades of Lookout Avenue need not be disturbed, neither the existing viaduct of the street Railway Company.

Furthermore, the travel from south into the heart of the Borough will be facilitated because the new grades of the highways will be substantially level where they cross the deep valley of the stream. Now the travel is compelled to pass down into the valley and thence up steep grades to the principal portion of the Borough.

The disadvantages relate principally to the injury to property along Centre Avenue and to the re-arrangement in the matter of getting to and from the Baltimore and Ohio freight and passenger stations. However, these disadvantages would not seem to warrant the expenditure of over a million dollars additional to secure the elevation of the railroad, and besides, the protest against this railroad elevation by the Standard Steel Car Company must necessarily be taken into account.

The elevation of the highways, viewed as a comprehensive plan, is a reasonable project, will confer the benefits desired at the least expense and permit the cost to be assumed and assessed gradually upon those interests that must contribute the funds.

The Commission has under consideration the plans and specifications of the viaduct, which have been approved with slight modifications by the Engineering Bureau.

b—Wilkes-Barre, Butler Street Viaduct.

Extension of Butler Street over the Tracks of the Lehigh Valley Railroad, Central Railroad of New Jersey, Delaware and Hudson Railroad and Pennsylvania Railroad in the City of Wilkes-Barre.

The proposed viaduct will be 1,350 feet long. The city had laid out a new highway across the said territory and railroad tracks. Therefore, the viaduct will not abolish a lawfully existing grade crossing. However, it happens that many citizens do cross the tracks at the point in question, although they trespass in doing so. Not a few of these trespassers are men employed by the said interested railroads or by corporations subsidiary to the railroads, and it has been agreed by the city and the railroad companies that common interests dictate that a public overhead crossing shall be provided here.

Pennsylvania Avenue is a thoroughfare. It is paved with brick, has flagged sidewalks and is lined with dwellings in the vicinity of Butler Street. This avenue parallels the railroad and is distant therefrom about 400 feet. At Butler Street, Pennsylvania Avenue has a lower elevation than the said railroad tracks. West of Pennsylvania Avenue there is a thickly built-up section of the city known as North Wilkes-Barre. East of the railroad tracks is the section known as East Wilkes-Barre. It contains a population of about 4,000. This territory will never in all probability be extensively developed as a residential district because the lands are principally owned by coal companies and are occupied by collieries and breakers, or held for mine operation purposes. However, there is a large amount of through travel as well as local travel between the said north and east sections of Wilkes-Barre and at present this travel has to cross the railroads either at Conyngham Avenue which is 2,000 feet to the north where the crossing is at grade, or at Scott Street which is about the same distance to the south, where the highway passes under the Lehigh Valley tracks and at grade across the Delaware and Hudson tracks and the Central Railroad tracks.

From an examination of the ground it will appear that when the grade crossings at Conyngham Avenue and Scott Street and at other streets in Wilkes-Barre along the lines of the said railroad are abolished, it will not involve a change in the elevation of the railroads at Scott Street and Conyngham Avenue and hence not at the site of the proposed viaduct at Butler Street.

The plans for the Butler Street viaduct call for a vertical clearance above the tracks of the railroads of at least 22 feet. In order to obtain this height without disturbing the existing grade of Pennsylvania Avenue, it is necessary to have the approach on the Pennsylvania Avenue end at a grade of 7.38 per cent. This is in excess of good practice. Eastwardly from the railroads the roadway of the viaduct will have a descending slope of 3.62 per cent.

As previously stated, Pennsylvania Avenue is paved and lined with residences. To raise the elevation of the avenue sufficiently to reduce the said grade of 7.38 per cent. to 5 per cent. would affect the present sidewalk and street grades in front of 70 dwellings located along Pennsylvania Avenue and on Butler, Thompson, John and Chester streets, which extend laterally from the Avenue.

It is estimated that the viaduct as now planned, including damages, will cost \$110,000. The City does not wish to expend over \$50,000 on the project. When the proposition to abolish all the grade crossings in the city was submitted to the voters, there was an item of \$35,000 as the City's share for the Butler Street over crossing. If we assume that the damages to the said 70 above properties would be at least \$40,000 the entire improvement would cost \$150,000 of which the City would have to pay, let us say, between \$75,000 and \$100,000. Probably \$100,000 is nearer what the City would finally pay as its share of such cost.

There is a trolley track in Pennsylvania Avenue. The proposed viaduct is to be 50 feet wide and is designed to sustain heavy street car traffic, should this ever be required. For the present, however, the Wilkes-Barre Railway Company will not lay tracks on the viaduct and will not assume any share of the expense of the bridge. Automobiles and heavy trucks and fire apparatus, however, will use the viaduct.

Some cities will not accept plans that call for a street grade in excess of 5 per cent. and strive to obtain grades of less slope. Here the City of Wilkes-Barre proposes, of its own accord, to establish a steep slope down on to a main thoroughfare where there is a trolley track running at right angles to the line of said steep declivity. The City Planning Commission has required the modification of the plans, namely the widening out of the approach at the foot of the slope in either direction at Pennsylvania Avenue so that vehicles may pass off the steep grade on to the Avenue in line with the traffic on said Avenue. This is as far as the City of Wilkes-Barre chooses to go at the present time. If the traffic becomes very considerable on the viaduct and public necessity then demands a lesser grade than 7.38 per cent., the City then at its own cost and expense, will take up the matter of reducing the grade and assume the cost at that time.

It is planned to pave the surface of the roadway on the steep slope with some one of the approved modern and so-called non-skidding surface materials. Some further minor changes in the design of the structure will be made before the plans and specifications are finally submitted for the approval of The Public Service Commission. Special traffic regulation relating to the traffic on the viaduct should be ordained by the City and enforced.

c—Homewood Hollow Viaduct.

The Pittsburgh, Harmony, Butler and New Castle Railway Company is extending its lines through the Borough of Homewood, Beaver County, and also across the highway leading eastward from Homewood Station to the river. The plans call for the erection of a viaduct known as the Homewood Hollow Viaduct, a steel structure 340 feet long comprising five spans, the shortest one being 30 feet, and

the longest being 80 feet. Near the top of the slope into Homewood Hollow on one side of the viaduct there is an old public road, little used, over which the said viaduct is to be carried with a span of 40 feet. The vertical clearance between the bridge and the surface of the road beneath is to be 15 feet. The girder will rest on a concrete pier at one end upon a steel tower at the other end, the road being about midway of the 40 foot span.

The plans were approved by the Public Service Commission.

d—Kohinoor Viaduct.

The Schuylkill Railway Company was notified by the State Railroad Commission of the unsafe condition of a trestle carrying the said electric railway over the tracks of the Philadelphia and Reading Railway in West Mahanoy Township, Schuylkill County. This was sometime during the year 1913. Changes were ordered but were not carried out, and finally in the spring of 1914, the State Railroad Commission having been superseded by the Public Service Commission, the latter notified the said electric railway company substantially to the effect, that if progress had not been made towards putting the structure in safe condition on or before April 1st, an order would be issued suspending traffic over the bridge. In pursuance of this last notification, the two railway companies interested drew up an agreement whereby the said Schuylkill Railway Company in the reconstruction of its railway ordered by the Public Service Commission, was to cross the tracks, right of way and property of the Shenandoah Branch of the Philadelphia and Reading Railway at two points, with a single track by overhead bridges, to be constructed approximately in the manner shown by a plan, said points of crossing being approximately 6,573 feet south of Shenandoah Station.

The plans provided that the electric railway shall cross over the steam railroad tracks upon a metal viaduct supported by metal columns on concrete abutments, with a head room of not less than 23 feet in the clear at one point and not less than 25 feet at the other point of crossing, and that there shall be a clear span of not less than 46 feet at the first point of crossing and not less than 42 feet at the other point of crossing.

Temporary repairs were made to the existing wooden structure. Single truck cars only were then run over the bridge and frequent inspections were made by agents of the Company as a necessary part of the safe operation of public traffic at this point. The foundations of the structure rested upon insecure ground, made so by reason of coal mining operations. Frequent settlements of ground occurred not only at the bridge but at other points along the route of this company's line in the Shenandoah Valley. A cave-in may occur at any moment.

This line extends down the valley to Girardville and it is the main means of transportation to the citizens of the numerous mining settlements in the district. To suspend traffic altogether over the old bridge would have required the patrons to descend a flight of steps to be built on the steep hillside from the trolley tracks to the highway below in the valley where they would have been obliged to cross at grade the tracks of the Philadelphia and Reading Railway Company; or a temporary bridge for foot passengers would have to be erected over the said steam railroad tracks; thence the patrons would have had to walk along the highway in the valley for several hundred feet and then climb a flight of steps to the roadbed of the trolley line at the other end of the viaduct. By the placing of bracing iron girders, additional trusses and replacement of unsound timber, the bridge was considered temporarily safe enough for the continued operation of single truck

cars over it. The proposed relocation of the viaduct is substantially along the property line between the Girard Estate and the Gilbert Estate. Here is maintained what is known as a barrier pillar not less than 50, or more than 200 feet wide. In this stretch of ground the removal of coal is not permitted and hence the foundation for the new structure, if resting on this barrier pillar, will be more secure than if it were placed in the location of the existing bridge. However, the approaches to the proposed viaduct will not be more secure than the approaches and the bridge have been.

Subject to a few modifications, the plans for the viaduct were approved.

e—Mahoning Avenue Viaduct.

Proposed Abolition of Grade Crossings at and in the Vicinity of Gardner Avenue, City of New Castle, Lawrence Co., Pa.

About ten years ago a project to construct a viaduct for highway traffic across the valley of the Shenango River, through the lower part of the City of New Castle, was considered jointly by the authorities of the said City and the County Commissioners. At that time the City, in contemplation of this improvement laid out a new highway, which may be designated as the Mahoning Avenue Extension, and the County Commissioners took over this extension and legally occupied it, so I am informed. However, the estimated cost of the viaduct having been found to be in the neighborhood of \$600,000.00, the project of building the structure was abandoned. It was revived by the County Commissioners during the year 1911, and plans and specifications were well along, so it is reported, for a shorter and much less expensive viaduct—substantially the project that is now under consideration by the County—when the flood of March, 1913, occurred, destroying the highway bridge at Gardner Avenue, which highway bridge was to be abandoned and substituted by the proposed viaduct. This destruction of the Gardner Avenue Bridge over which the traffic from Mahoning Avenue is carried, interjected a new element into the project—namely, that of the Commonwealth—since the Shenango River at this point is a navigable stream and the Commonwealth has obligated itself to reconstruct highway bridges that may be destroyed by flood on navigable streams in Pennsylvania.

In pursuance of law and the petition of the Commissioners of Lawrence County for a bridge across the Shenango River at Gardner Avenue, the Court of Common Pleas of Dauphin County appointed viewers to examine the location and report May 25th, 1913. At a meeting of said viewers on May 17th, Charles Adams, Esq., represented the Attorney General of Pennsylvania and Mr. J. V. McNary represented the State Highway Commission of Pennsylvania. The Commissioners of Lawrence County were present with their Attorney, William McElwee, Jr., and their Bridge Engineer, Thomas Gilkey.

It was ascertained that the Gardner Avenue Bridge, destroyed by flood and high water, March 27th, 1913, was a through 3-span Pratt Truss, with inclined end posts, steel highway bridge, with a roadway 20 feet in the clear and with sidewalks 6 feet wide on each side thereof; the floors of said roadway and sidewalk being of plank. The abutments and piers were of bridge masonry. The total length of the bridge was 380 feet, and its roadway floor elevated about 13 feet above the ordinary stage of water in the Shenango River.

This bridge connected the seventh and eighth wards of the said City. It supported the single track of the Mahoning and Shenango Street Railway Company.

The Viewers found that the accommodation of the travelling public in the said locality demands the rebuilding of the bridge which was a County bridge, having been erected by the County Commissioners in pursuance of an order of the Court at No. 3 March Sessions, 1890, 24 years ago, and was the first bridge built on said site. The Viewers reported that to rebuild a bridge on that site at the same elevation of the old structure to accommodate the traveling public, would cost \$60,000.00.

The Viewers further found and reported as follows:

That about 560 feet south of and practically parallel with said Gardner Avenue, by City Ordinance approved November 12, 1901, recorded Ordinance Book 5, page 245, the said City of New Castle ordained a 50 foot street calling the same Mahoning Extension. That at No. 7 December Sessions, 1901, Common Pleas of said Lawrence County, will be found the authority to said Lawrence County to build a 'bridge from Moravia Street over railroads and Shenango River,' with this final endorsement "April 7, 1902 above findings of Grand Jury and report of viewers approved By the Court."

That said 50 foot ordained Mahoning Avenue Extension and said proposed bridge over railroads and Shenango River are not now actually built.

That from the point marked A to the point marked B on plan of Gardner Avenue herewith, are nine busy railroad tracks crossing said Gardner Avenue at grade.

That said Gardner Avenue is the main artery of travel from the Seventh Ward of the said City of New Castle to the rest of the City and that from five to ten thousand citizens of said City cross said Shenango River at the location of said destroyed bridge going to and from their daily work. That said Gardner Avenue is the route of the local double tracked street railway.

That by reason of said nine grade crossings, the public travel on said Gardner Avenue of the grade of the said destroyed bridge has become intolerably dangerous to said travelling public.

That in the opinion of your viewers it is imperatively necessary for the proper accommodation and safety of the travelling public that said destroyed bridge be rebuilt at an elevation sufficient to permit the building and construction of over-head crossings over said railroads, to-wit: the tracks of the Allegheny and Western Railroad, operated by the New York Central Lines, the tracks of the Erie Railroad, operated by the New York Central lines, and the tracks of the Pittsburgh and Western Railroad, operated by the Baltimore and Ohio Railroad. See plan herewith. That the old bridge was destroyed because of insufficient waterway under it.

That the elevation of the proposed new bridge as aforesaid, will in addition to above, greatly insure its safety against flood and high water.

That contracts can and should be made by the Commonwealth of Pennsylvania, through its Board of Public Grounds and Buildings, or otherwise, with the said City of New Castle, the said County of Lawrence, and the several railroad and street railroads interested, for the erection and construction of the approaches to said proposed bridge to be built at the elevation set out herein. All the findings under this Caption Nine we so report.

Accordingly the Viewers recommended the new location to be over the Shenango River on said Mahoning Avenue Extension, a fifty foot street, ordained as aforesaid, to be 560 feet south of and down said Shenango River from the site of the said destroyed Gardner Avenue Bridge; and the Viewers recommended that in lieu of the rebuilding by the Commonwealth of said destroyed Gardner Avenue Bridge, that a reinforced concrete arch bridge, having a clear waterway of 300 feet, a roadway of 30 feet, paved with brick, sidewalks on each side of ten feet, the clear waterway to consist of not more than three channel arches of 100 feet each, to be constructed, towards the expenses of which the Commonwealth should contribute \$60,000.00, the probable cost of replacing the old bridge.

This report was confirmed by the Court on July 9th, 1913, and the bridge was directed to be rebuilt by the Commonwealth of Pennsylvania, in accordance with the recommendations of the Viewers.

The City of New Castle, having a population of about 40,000 people is located in the Shenango and Mahoning River Valleys, just above the point where these streams combine to form the Beaver River. Entering the City from the extreme northwest corner is Neshannock River, which joins the Shenango River near the center of the City; and just above the confluence of these two streams and lying between them is a flat low area of land, covering about 650 acres, upon which is located a large portion of the business and manufacturing interests of the City. This area, as well as that lying on the southeast side of the creek, has been subject to inundations and damage by floods for many years, and the problem of protecting this area from further flood and damage has been the subject of special study by the City since the flood of March, 1913, and also by the State Water Supply Commission.

The Shenango River above New Castle has a drainage area of approximately 840 square miles. The topography of its watershed is generally hilly, but also contains some flat swampy areas. The river passes through the westerly and central portions of the City of New Castle and it is bordered on the east bank by the Erie Railroad, which to a large extent has formed an effective barrier against the direct flooding of the low portions of this City, although the back water from the Shenango River, passing up and overflowing the Neshannock Creek channel, has caused damage several times in the past.

The flood of March, 1913, raised the waters of the Shenango to a height never before equaled and caused them to break through the Erie Railroad embankment at a point over a half mile up stream above the Gardner Avenue bridge, near Grand Avenue, and flood the City.

The General Assembly of 1913, approved plans of the Pennsylvania Water Supply Commission for the construction of a large reservoir near the headwaters of the Shenango, above Greenville, and provided an appropriation for the beginning of this work, which, when completed, will reduce the danger of floods in the Shenango Valley, but not entirely eliminate them at New Castle.

The Gardner Avenue crossing of the Shenango River is located a short distance down stream from the confluence of the Shenango River and Neshannock Creek. It is the main highway across the valley in the lower portion of the City and it is a part of the comprehensive State Highway System of main routes in and out of New Castle.

The Board of Commissioners of Public Grounds and Buildings of the Commonwealth, proceeded according to law to appoint an engineer to draw up plans and specifications for the bridge, his compensation to be fixed by the County of Lawrence.

Mr. Emil Swensson, of Pittsburgh, was the engineer selected, and he prepared a general preliminary plan and an approximate estimated cost thereof. In the matter of building the new bridge and viaduct at the Mahoning Avenue Extension, in lieu of the site at the old Gardner Avenue Bridge, the County of Lawrence, the City of New Castle, the Youngstown Street Railway Company, the Buffalo, Rochester and Pittsburgh Railway Company, the Erie Railroad Company, the Pittsburgh and Lake Erie Railroad Company, the Baltimore and Ohio Railroad Company, and the State of Pennsylvania are proportionately interested and an effort has been made by Mr. Swensson to have said general plan approved by each and every one of the parties interested, before contract plans and specifications can be proceeded with.

This was substantially the situation at the close of the fiscal year.

A-6. GRADE CROSSINGS IN THE CITY OF READING.

In regard to the abolition of crossings at grade of the highways and tracks of the Philadelphia and Reading Railway in the City of Reading, conferences were had by the engineer of the Commission with his honor, Ira W. Stratton, the Mayor, and other city officials having such matter in charge. These officials have done nothing in the way towards the preparation of practicable plans for the abolition of the said grade crossings. It is true that much correspondence has ensued between the City and the railway company officials, but no encouragement has been received by the City from the said company in the matter of eliminating said grade crossings.

It was the hope of the Mayor and city councils that the Public Service Commission would initiate the surveys and make the plans for the said elimination. However, it was deemed impracticable by the Commission thus early in its history, and with the small force in its employ and at its command, owing to limited funds, to inaugurate the policy of initiative and preparation of detail plans for big projects of this kind. This determination by the Commission was a disappointment to the City of Reading. However, the Commission did inform the Mayor that it would act upon such plans as might be prepared either by one or both of the parties interested in Reading.

The result of the conference of the engineer of the Commission with the said city officials was to bring out the fact that the city would, if found absolutely necessary, employ a competent expert engineer, skilled in these matters, to study the problem and to prepare plans for the elimination of the grade crossings at Penn Street and at Franklin Street and at such other streets along the main line of the Reading Railway as would necessarily be involved in the project. However, it was the unanimous opinion of the city council that the engineering ought to be initiated by the Railway Company, more especially since the problem involves changes in the Franklin Street Passenger Station and probably at the Union Station and the Union Yards. It seemed to the City that no matter how competent an engineer it might employ, no plans could be evolved that would be as satisfactory to the Railway Company as those plans that might be prepared by the Railway Engineering Department. In consequence, the Mayor requested that the Public Service Commission endeavor to prevail upon the Railway Company to undertake the preparation of the plans either alone or in conjunction with the city, and that the work should be largely done by the railway engineers.

It appearing evident that much time and duplication of work could be saved in the preparation of the plans if the work be done by the Engineering Department of the Railway Company, a conference was had between the engineer of the Company and the engineer of the Commission. The outcome was exhibition of an evasive attitude on the part of the Company to take up the problem at the present time.

The Mayor is reported to have appointed the city engineer and the engineer of the water works to prepare plans and estimate of cost for the City, but at the expiration of the fiscal year no funds or adequate amounts of money had been provided for the prosecution of this work.

A-7. WILKES-BARRE CONNECTING RAILROAD.

Abolition of certain grade crossings in Wilkes-Barre and vicinity by the construction of a connecting railroad around the City.

General Conditions.

The City of Wilkes-Barre is located along the east bank of the Susquehanna River, partly on a level plateau a considerable portion of which, in the section known as South Wilkes-Barre, is subject to annual inundation,—a fact of relevance in this case,—and partly back on the hillsides which rise steadily to the summit

of the Wilkes-Barre Mountain. Opposite Wilkes-Barre are extensive flats about a mile and a half wide which are also largely subject to inundation during extraordinary floods. In spite of this the land has become extensively occupied by dwellings and here may be found the Boroughs of Edwardsville, Dorranceton and Forty-fort.

On the north, Wilkes-Barre is bounded by Mill Creek, the Township of Plains and the Borough of Parsons and Miners Mills.

In the City, back from the river where the flats end, may be found the tracks of the Pennsylvania Railroad, the Lehigh Valley Railroad, the Central Railroad of New Jersey and the Delaware and Hudson Railroad, all side by side. In the outskirts of the City, these railroads branch in various directions.

Excluding that section of South Wilkes-Barre where the connecting line is being built and the extreme eastern portion of Wilkes-Barre where there are two or three crossings which have no relevance to the matter in hand, there are in the City 27 streets which are crossed by steam railroads. Such crossings at grade number in all 44 and such crossings either over or under the railroad tracks number 7. In the following table the names of these streets and the number and class of crossing are given:

Crossings of Steam Railroads and Highways in the Central Part of Wilkes-Barre.

Highway.	At grade.	Street over or under railroad.	Total.
Division Street,	1	.....	1
Horton Street,	1	.....	1
Barney Street,	1	.....	1
Franklin Street,	1	.....	1
Main Street,	5	.....	5
Old River Road,	1	.....	1
Carey Avenue,	1	.....	1
Wood Street,	1	.....	1
Race Street,	1	.....	1
Hanover Street,	1	.....	1
Parrish Street,	1	.....	1
Blackman Street,	1	.....	1
Walnut Street,	1	.....	1
Dana Street,	1	.....	1
Hazle Avenue,	1	.....	1
South Street,	1	3	4
Northampton Street,	1	.....	1
Lehigh Street,	1	.....	1
Hill Street,	1	.....	1
Pennsylvania Avenue,	2	.....	2
River Street,	1	.....	1
North Street,	1	.....	1
Market Street,	1	.....	1
Conyngham Avenue,	3	.....	3
Johnson Street,	1	.....	1
Scott Street,	1	1	2
Washington Street,	1	1	2
	44	7	51

The streets in the table are named in order in passing through the City from the south to the north.

In addition there are four points in the city where a railroad crosses a railroad at grade. This makes a grand total of 55 railroad crossings.

Summary.

Grade crossings—

Highways and steam railroads,	44	
Railroads and railroads,	4	
		48

Crossings over or under railroads—

Highways over railroads,	6	
Highways under railroads,	1	
		7

Grand total,	55
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In several of the highways there are street railway tracks which cross the railroad. There are also numerous switches into industrial plants. The Pennsylvania Railroad and the D. & H. Railroad have respectively 8 and 9 street grade crossings. The Central Railroad and the Lehigh Railroad have, respectively, 12 and 15 street grade crossings. Each of these railroads maintains a crossing at grade of another railroad. The number and kind of crossings of these four railroads in the section of the City under discussion are shown in the following tabular statement:

Classification of Railroad Crossings.

Railroad Company.	Street Crossings.				Across Railroad by R. R.	
	At grade.	Street over.	Street under.	Total street crossings.	At grade.	Total R. R. Across R. R.
Penna.,	8	1	0	0	1	1
D. & H.,	9	0	0	9	1	1
Central,	12	2	0	14	1	1
Lehigh,	15	3	1	19	1	1
Totals,	44	6	1	51	4	4

The City endeavored to bring about an abolition of these crossings. A comprehensive plan was agreed upon by the parties in interest. The project involved an estimated cost of \$3,000,000, of which the City was to pay \$900,000. This proposition was submitted to the voters of the City early in the year 1912 and was defeated.

The Pennsylvania Company and the D. & H Company then entered into a working agreement which brought about the incorporation of the Wilkes-Barre Connecting Railroad Company under the laws of Pennsylvania. This was in November, 1912. The principal reasons for this action was to avoid the charges paid by these two railroad companies to the Lehigh Valley Company for transference of traffic between the two over the Lehigh's tracks.

The Pennsylvania Railroad enters Wilkes-Barre from the south and ends in the center of the City. The D. & H. Railroad tracks enter from the north and end in the center of the City. There is a space intervening between these two ends in the center of the City that is traversed by the Lehigh Valley tracks. The D. & H. has a branch line from Plymouth which enters South Wilkes-Barre, and terminates

in a connection with the Pennsylvania and the Lehigh tracks. The only way that the cars of the D. & H. and Pennsylvania Lines can pass northerly to the other tracks of the D. & H. in Wilkes-Barre, or vice versa, is by use of the tracks of the Lehigh Valley Railroad (or the Central) traversing the narrow zone in the centre of the City. It is stated that this transference amounts to many train movements each 24 hours and that the annual charges amount to a sum sufficient to warrant the cost of the building of the proposed connecting line around the city between the tracks of the Pennsylvania and the D. & H. on the south and the main line of the D. & H. to the north of the City in Plains Township. Furthermore, the avoidance of great delay in train movements through the City, due to switching and hold-ups at grade crossings has been an important consideration. By means of the new connecting line around the City instead of train movements comprising a few cars per movement, the traffic will be composed of heavy slow moving trains of many cars, thus shortening the time of transit and reducing the cost of operation.

It will be possible in the future to send through Lehigh freight trains around the city over the proposed connecting line if this were found to be desirable.

It is not contemplated by the railroads to give up any of their holdings in the city, or to abandon the use of their lines and track facilities to industrial plants; but the improvement will relieve the congestion of traffic due to the haulage of freight through the City, and to this extent, materially reduce the existing delay to the street traffic, at the highway crossings hereinbefore mentioned.

Proposed Wilkes-Barre Connecting Railroad.

This road is to be 7 miles long. It is to begin at a point of connection with the Northern Coal and Iron Company's railroad (understood to be a subsidiary of the D. & H.) at or near Hudson Station on the D. & H. Railroad in Plains Township, thence westerly through Plains Township, Miners Mills Borough, and in said township, passing by and near Parsons Borough and the City of Wilkes-Barre to the Susquehanna River, near the mouth of Mill Creek; thence across the said river and southerly along the flats through the Boroughs of Dorranceton and Edwardsville to the Susquehanna River; and thence across said river and through a new developed section of Wilkes-Barre, commonly termed South Wilkes-Barre, to Hanover Township; and thence continuing southerly in said township to a connection with the Sunbury Division of the Pennsylvania at Buttonwood in said township.

The said connecting railroad is planned to pass over 16 highways, over 4 steam railroads, over 1 express electric railway, over 2 farm lands. It is also planned to cross at grade 4 highways and 1 steam railroad, and by the plan, 1 street grade crossing will be abolished, making a total of 5 grade crossings proposed and 23 overhead crossings.

At Hudson the facilities of the Northern Coal and Iron Company yards will be utilized for storage purposes.

Over the Susquehanna River at the south of Mill Creek the existing bridge and tracks, for some distance on either side, of the Wilkes-Barre and Eastern Railroad Company will be utilized, enlarged and improved. The said Wilkes-Barre and Eastern Railroad was constructed many years ago. A passenger station was built on the flats at Market Street in Dorranceton, opposite the City and on the west bank of the river. From this point the road was built on an embankment northerly to the river and thence over the river and through Plains Township easterly for a number of miles. For a number of years past, that portion of the road from Plains village back of Miners Mills Borough easterly has been the only part of

the railroad that has been operated. The Wilkes-Barre Connecting Railroad Company has secured certain rights and will double track the bridge over the river for its own purposes and the use of the said Wilkes-Barre and Eastern Company; and will also provide an additional track for the Delaware, Leckawanna and Western Railroad Company that has a prior right and is constructing a narrow gauge mine track extending from the "Peach Orchard" Colliery near Parsons to the Pettibone Beraker in Dorranceton Borough to the north.

The Wilkes-Barre Connecting Railroad Company will also widen the existing bridge of the Wilkes-Barre and Eastern Railroad over the tracks of the Lackawanna and Wyoming Valley Railroad (Laurel Line) and the Harveys Lake Branch of the Lehigh Valley Railroad, and the existing bridge of the said Wilkes-Barre and Eastern Railroad over North River Street, and the existing bridge under said Wilkes-Barre and Eastern Railroad over the tracks of the Lehigh Valley Railroad and the Central Railroad of New Jersey so as to carry two standard gage tracks and one narrow gauge track, all as agreed upon by the parties mentioned. It is represented that the Wilkes-Barre Connecting Railroad Company will maintain the bridges and facilities provided by it and used by the said Wilkes-Barre and Eastern and the said D. L. & W. Railroad Companies.

In Hanover Township and South Wilkes-Barre, the existing track and bridges and facilities of the Northern Coal and Iron Company will be utilized. Said Northern Coal and Iron Company (hereinafter referred to as the Plymouth Branch of the D. & H.) operates a coal railroad from Plymouth Borough or Larksville Borough west of South Wilkes-Barre on the opposite bank of the Susquehanna River, southerly over the river and across certain highways in Wilkes-Barre to a connection with the Lehigh Valley Railroad. About 8 years ago, what is known as the Buttonwood Branch of the said Northern Coal and Iron Company (hereinafter referred to as the Buttonwood Branch of the Delaware and Hudson Railroad) was constructed from a point of connection with the Sunbury Division of the Pennsylvania Railroad at Buttonwood in Hanover Township, northerly for a distance of over a mile in said township, crossing at grade the Plymouth Ferry Road and being carried over Carey Avenue and also a farm lane in said township, to the City of Wilkes-Barre line; thence it continued northerly in said City a distance of three-fifths of a mile to and connected with the Plymouth Branch of the D. & H., being carried over the following streets by through plate girder bridges built for double track. The overhead bridge at Carey Avenue is also double tracked.

Tabular Statement as to Existing Street Crossings.

Street crossing.	Vert. clearance bet. St. surface & bottom of bridge above.	Street span.	Proposed Alterations.
Old Ferry Road,	At Grade	.....	.....
Carey Avenue,	14.5 ft.	Bridge column in street centre,	None.
Simpson St.,	12.0 ft.	Columns in street gutter,	None.
Willow St.,	12.0 ft.	Clear span,	None.
Oak Street,	12.0 ft.	Clear span,	None.
Lawrence St.,	13.0 ft.	Clear span,	None.
Horton St.,	16.0 ft.	Clear span,	Bridge to be raised 2.5 ft.
Dagabert St.,	16.0 ft.	Clear span,	Bridge to be raised 5 ft.

Between Dagabert Street and the said Plymouth Branch there now exists what is called an overflow bridge. It is a steel deck girder structure wide enough for two tracks and being supported on masonry piers, four in number, between the abutments. The land is low here and during flood times a very considerable body of water passes over the surface of the ground southwesterly towards the river from a point further up the valley. If the openings were not provided, the flood waters would pond up and do more damage than now. This structure is to be widened and raised from 5 to 10 feet in height and will be carried over the Catlin Farm lane, that is to say, the tracks extending beyond this overflow bridge will be carried over the lane and be connected to the proposed new construction to be built by the Wilkes-Barre Connecting Railroad.

These facilities of the Buttonwood Branch of the D. & H. Railroad have been acquired and will form a part of the Wilkes-Barre Connecting Railroad. This was done prior to the creation of the Public Service Commission, so it is represented.

The new construction work proposed by the Wilkes-Barre Connecting Railroad Company is to comprise the double tracking of the existing Buttonwood Branch and the elevation of the grades thereof approaching the tracks of the said Plymouth Branch in order that the said connecting railroad shall pass over the existing tracks of the said Plymouth Branch at the point where these two lines intersect at right angles. The clearance here is to be 18 feet only in height. The horizontal clearance between abutments is to be 57 feet, which provides for the three existing parallel tracks of the Plymouth Branch and one additional track. The plan filed by the petitioner shows the vertical distance between the top of the rail and the bottom of the main girder above of 17 feet 11 inches. The petitioner's written statement is as follows

"The said Northern Coal and Iron Company has consented that the crossing may be made as proposed and is satisfied with the plans as submitted."

It is good practice to have a vertical head room of 22 feet. There are quite a number of 18 foot clearances in existence. As the Plymouth Branch is not much more than a switch to the coal breakers across the river, and as the expense involved of increasing the proposed clearance would be very considerable, it is believed by both railroads concerned that the proposed plans are absolutely the most practicable, so it is presented by the petitioner. The railroad crossed has not objected but there is no copy of the agreement between the two companies on file in the Commission's office.

Bearing in mind that coal cars are not as high as box cars that are used on general traffic lines, it would appear that the contention of the petitioner relative to the head room at this particular crossing be reasonably sustained, and more especially since this point of crossing is the summit of the grades in either direction of the proposed connecting railroad.

The height of the proposed bridge over the Susquehanna River and its design has been determined by consideration of a waterway beneath and clearance over the highways on the flats in Dorranceton. This bridge is to be located where the main stream formerly consisted of two channels, separated by Fish Island. The North Channel is completely filled with culm and silt and at its upstream end was at one time blocked off with jetty, erected by the U. S. Government to maintain navigation. The bridge is to have 7 spans, the north abutment and 3 spans being over a portion of Fish Island, which is to be excavated. The channel north of the island will be crossed by fill. At present this channel only carries water at normal flood. There are to be 7 through truss spans, each 173 feet in length to support the tracks over the road along the bank of the river, which road is known as the Riverside Boulevard.

The tops of the piers are to be elevation 539 and the under clearance line of the steel work at elevation 542. The maximum flood elevation at this point is 538. The normal surface of the water is elevation 505 and the bed of the river at the deepest section is approximately 497. So it may be noted that the tops of the piers are located one foot above maximum flood height, and the under clearance of the bridge is four feet above this height and 37 feet above normal water elevation and 45 feet above the bed of the stream.

The normal width of the south channel of the river here is 750 feet and the entire length of the proposed grade from the north abutment to the south river bank is 1211 feet, so that approximately 460 feet of Fish Island are to be spanned by the bridge. As before stated, it is proposed to excavate the island from the river edge on the north bank to the north abutment, the material amounting to about one million cubic yards of culm, gravel, sand and clay to be used in making the embankment to support the railroad across the flats and north of the north abutment of the bridge. This excavating of the island will increase the width of the river at this point to an average of 1,200 feet.

The State Water Supply Commission has approved this structure with the stipulation:

1. That the material excavated from abutment and pier foundations be deposited at points to be approved by the Commission.
2. That in case navigation is improved on this river by State or Federal authorities, the applicants agree to install a draw span in this bridge at their own expense, if required.
3. That all false work piling, used in the construction of the superstructure or piers or abutments, be removed from the river when the work is completed.

In South Wilkes-Barre, between the railroad bridge and the crossing over the Plymouth Branch of the D. & H., the proposed connecting line will cross by overhead bridges the following streets. Marlborough, Amherst, Maffet and Miner. Also Riverside Boulevard, hereinbefore referred to. The crossing of Academy and Birch Streets will be avoided by extending Pickering Street parallel to the railroad to intersect the two.

With respect to the streets and matters of drainage flood protection, etc., the City of Wilkes-Barre, the land owners and the railroad company are now conferring, and it is probable that one or all of these 4 proposed crossings may be entirely abandoned by substituting a fill over them and the construction of a flood dyke along the south bank of the river. To this end an agreement in writing is now being considered and if signed, a copy will be presented to the Commission, and the petitioners will ask for a modification of the plan to conform to the provisions of the agreement.

The railroad embankment through the flats in Edwardsville and Dorranceton is being surface lined to above the flood level with concrete slabs. At Northampton and Pierce Streets clear span bridges are provided with head rooms of 17 and 20 feet respectively. At Market Street the vertical clearance is 14 feet 10 inches only, between the under side of the plate girder and the street car rails, all local parties in interest having agreed to this height.

Relative to the Wilkes-Barre and Eastern Railroad bridge over the river at the mouth of Mill Creek, which is to be improved and used as a part of the proposed connecting line, this bridge at present consists of six spans over the river proper and a crossing over the Lehigh Valley Branch Line standard gauge and a mine

track narrow gauge and over the two tracks of the Laurel Electric Railway. The latter are located on an embankment along the east bank of the river; vertical head room 16 feet plus. The said Lehigh tracks are parallel to the Laurel Line but located in a depression with a vertical clearance of 32 feet. The span across the Laurel Line is 35 feet and across the Lehigh tracks 65 feet with an intervening connecting span of 17.5 feet. The rails will be raised 1.31 feet above the present level and new plate girders will be placed on the existing piers and abutments, this being made necessary on account of the heavier trains and traffic proposed for the said connecting railroad.

The clearance line of the bridge over the river on the Wilkes-Barre side is elevation 352, or 11.2 feet above high watermark. The grade descends so that at the west abutment on the other side of the river the clearance elevation is 549 or 8.2 feet above maximum flood.

In utilizing this structure, the applicant proposed adding 5 short deck girded spans, 3 of which were to be 60 feet centre to centre of piers, and the other two 75 feet each; these additional spans to be on the Dorranceton flats beyond the west end of the present bridge, they being provided to afford a passage way for flood waters. The plan provided that the approach to this bridge with the additional spans should be on fill 45 feet high with side slopes 1.5 to 1, the fill being on a 4° curve. The additional spans proposed would have afforded an increased waterway area of 2,210 square feet below the maximum flood line, making a total of 30,271 square feet under the bridge as proposed to be altered. The following information was furnished by the applicant:

Comparative Statement of Flood Areas of Susquehanna River Bridges, Overflow Bridges, Etc., in the Vicinity of Wilkes-Barre, Pa., Below High Water, 1902 Flood.

Going Down Stream in Regular Order.	Degree of skew.	River bridge.	Clear Opening.		Total.
			Overflow Br. No. 1.	Overflow Br. No. 2.	
L. V. R. R. bridge, Port Bowkley,	70	30,000	.....	.....	30,800
W. B. & E. R. R., bridge,	80	28,061	2,210	.....	30,271
Pierce Street,	75	24,206	4,023	3,182	31,411
Market Street,	Slight	22,520	1,200	400	24,120
W. B. C. R. R., bridge,	60	37,400	.....	960	38,360
D. & H. Co., Plymouth Branch,	Slight	23,135	5,255	2,360	30,750
D. L. & W. R. R., bridge,	65	28,057	.....	8,094	36,151

It will be seen that the smallest bridge opening is at Market Street and that the next smallest, after adding the five additional spans, is the said existing bridge over the river at the mouth of Mill Creek. Past floods have clearly demonstrated that the Market Street bridge is insufficient. There is a project on foot to elevate Market Street across the flats and to build a new structure over the river.

The State Water Supply Commission approved the plans for the proposed alterations but required 8 spans to be built in addition to the existing bridge. The stipulations were as follows:

1. The Wilkes-Barre and Eastern Railroad bridge to be extended westwardly 8 spans, consisting of three 60 foot and five 75 foot plate girder spans, with a clearance to correspond with the sub-grade shown.
2. The material excavated from the foundations for that abutments and piers to be used in constructing the proposed fill and all false-work and coffer dams to be removed, where they lie below the flood elevation.
3. In case of the improvement of navigation in this stream, by State or Federal government, the applicant agrees to install a draw span, or make any other required change in the structure to facilitate navigation.
4. The slopes of the proposed fill to be protected by rip rap up to maximum flood elevation.

A project is being taken under advisement by the State Water Supply Commission, the Federal Government and the municipalities interested for the construction of a dyke along the west side of the Susquehanna River through the Boroughs of Forty-fort, Doiranceton and Edwardsville, in order to prevent the direct overflow of the river, which now takes place over the flats, immediately below the west abutment of the Lehigh Valley Railroad, Port Bowkley bridge in Forty-fort. This dyke, if built, will pass southerly to the west abutment of the proposed new bridge of the connecting railroad and thence southerly along the river to the north abutment of the proposed connecting railroad bridge at Fish Island. Such a dyke will eliminate the velocity when the floods inundate the fields, so that their submergence thereafter will be by back water only coming up from Fish Island. The depth of the submergence at the upper end of the plant would then be four or five feet less than at present.

With respect to the proposed overhead crossings at H and I (reference to the paper book and accompanying plans), there is nothing to offer of special interest except that the head room over River Street will be increased 15.75 feet. Over the main line of the Lehigh Valley there will be approximately 30 feet clearance and over 25 foot head room above the main track of the Central Railroad of New Jersey. Above the three mine tracks of the Lehigh Valley there will be a clearance of approximately 20 feet.

Proposed Grade Crossing in Plains Township at Main Street Extension.

This is a country road little used at present. It is not a main thoroughfare as the name would indicate, and it is not likely to become a future thoroughfare. In North Wilkes-Barre where the road crosses Mill Creek, it is named Main Street. Crossings at grade exist of the Lehigh Railroad tracks in the City and of the Lehigh and the Central Railroad tracks in the township. In the bottom of the valley near the creek. Thence the road ascends up a steep hillside and crosses at grade about half way up the hill the present tracks of the Wilkes-Barre and Eastern Railroad.

To make the situation worse, the crossing is at a very oblique angle. Along the oblique line from the existing railroad tracks, distant 130 feet further down the hill, will be built the narrow gauge mine track of the D. L. & W., and paralleling it two additional standard gauge tracks of the Wilkes-Barre Connecting Railroad. These three tracks will be laid on a bench and are or will be 10 feet lower in elevation than the W. B. & E. tracks. The railroad grade cannot be altered at this point to any substantial amount, so that if the crossing at grade is to be

abolished, the highway only must be changed. It is not practicable to carry the highway over the said four tracks and to carry the highway under at this time would involve an outlay of at least \$100,000, estimated. The traffic on the public road does not warrant this expenditure. There is not a dwelling or building on the highway within half a mile. The travel is almost entirely in and out of North Wilkes-Barre via River Street. Probably, if the time ever comes, for the crossing to be abolished, another location will be chosen, both for economy sake and the convenience of the public.

The township authorities desire some minor things to be done at this crossing, such as retaining walls, gates, etc. If possible, these matters should be the subject of an agreement between the said township authorities and the railroad company, and the written agreement should be filed with the Commission.

Crossing at Grade of Steam Railroads in Plains Township.

The D. L. & W. narrow gauge tracks will cross the double tracks of the connecting railroad at a point 700 feet east of the Main Street highway grade crossing in Plains Township. The tracks of the W. B. & E. Railroad will cross the tracks of the connecting railroad and the narrow gauge railroad at a point several hundred feet west of the said highway grade crossing. This is made necessary for the reason that the W. B. & E. Railroad deflects to the north in Plains Township and the narrow gauge railroad deflects to the south and crosses over Mill Creek via a steel viaduct on its way to "Peach Orchard." Where the three tracks are bridged over the river, the narrow gauge railroad is on the north side, the W. B. & E. Railroad on the south side and the connecting railroad is in the middle; hence, in deflecting to the north, the W. B. & E. tracks must cross the tracks of the other two railroads, and the narrow gauge road must cross the tracks of the other two railroads. The proposed grades of the connecting railroad, as previously stated, cannot be changed much, and it is not practicable to materially alter the grades of the other two railroads, more especially that of the W. B. & E. Railroad. The connecting railroad company proposes at its own cost to erect a signal tower and to operate the same in connection with interlocking signal protection for the several grade crossings hereinbefore mentioned and the company will file detail plans of the same with the Commission for its approval.

Agreement to avoid grade crossing of the tracks of the Central Railroad of New Jersey, Lehigh Valley Railroad and W. B. Connecting Railroad.

The Central Railroad Company of New Jersey leases and operates the Lehigh and Susquehanna Railroad including the so-called "Canal Branch." The Lehigh Coal and Navigation Company owns and has leased the said Lehigh and Susquehanna Railroad including said Canal Branch, to the said Central Company. The said Central and Lehigh Company have entered into an agreement with the Wilkes-Barre Connecting Railroad Company for the most advantageous construction of the latter railroad in Plains Township and Miners Mills. It is desirable to construct a portion of this new railroad on the lands and right of way of said Canal Branch now owned by the Lehigh Company and held, occupied and operated by the Central Company; namely, on that portion of said lands and right of way extending from Mill Street in Miners Mills Borough to a point in Hollenback Park in the Borough of Parsons and in the township of Plains. In order to so construct said line of railroad, it is necessary to re-locate the existing and operating tracks of said Canal Branch by removing the same from its present location to an alignment southerly

therefrom, and to provide therefor other lands and right of way. Such removal and relocation will improve the general conditions and facilities of said branch and avoid crossings thereof by the said proposed line of the connecting railroad. The agreement therefor provides for these things to be done. The Wilkes-Barre Company is to take up and remove from across the present existing track of the Canal Branch the grade crossing to N. J. Healey's Breaker, and to construct and maintain an undergrade crossing for a narrow gauge mine track under said relocated line at a point in the neighborhood of the existing grade crossing. The Wilkes-Barre Company has also agreed with the said Central Company and Lehigh Company to construct, maintain and operate crossing gates of approved pattern protecting the crossing of Mill Street in Miners Mills borough by the tracks of the Canal Branch and of said Wilkes-Barre Company, and to also protect the crossing of said tracks by the track or tracks of the Wilkes-Barre Railway (Traction) Company east of the said Mill Street.

The copy of the agreement of said companies has been filed in the office of the Public Service Commission.

Crossing at Grade of Mill Street and the Wilkes-Barre Street Railway in Miners Mills Borough.

The Central Railroad of New Jersey crosses said Mill Street in Miners Mills borough at grade and also at grade near Mill Street Railway. The Wilkes-Barre Connecting Railroad Company proposes to build double tracks across Mill Street at grade and across the said street railway at grade. The new tracks will be parallel to and not over one hundred feet distant from the said Central tracks. They will be 8 feet higher in elevation because Mill Street rises on a steep grade here. The situation is a dangerous one. Practically all the travel from Plains village to Miners Mills borough comes by this crossing. It is perfectly practicable to avoid this crossing at grade of the highway and the street railway by the construction of an overhead street viaduct that shall carry a trolley and street traffic. The cost of this project need not be prohibitive. It would mean the abolition of two existing grade crossings and the prevention of two additional grade crossings. The trolley company has agreed with the connecting railway company for the additional crossing, but the borough of Miners Mills will protest against the establishment of a grade crossing here. The grade of the connecting railroad cannot be altered. It is not practicable to carry the highway and trolley track under the railroad because Mill Creek is about 200 feet distant and but a few feet lower in elevation. Furthermore, the Central Road has a switch into the mills at this point and a connection to the Lehigh Valley tracks, so that but one thing can be done, namely, as hereinbefore stated, to elevate the highway and the trolley tracks. Mr. McMartin stated that his company would prepare the plans for this modification if ordered so to do by the Commission. However, said company does not wish to be delayed in the construction of other portions of the connecting line which may meet with the approval of the Commission by reason of alterations in the plans at Mill Street which the Public Service Commission might order.

Concerned in Mill Street and Vicinity are the following corporations:

Miners Mills Borough,
Central Railroad of New Jersey,
Lehigh Coal and Navigation Company,
The Wilkes-Barre Connecting Railroad Company,
The Wilkes-Barre Railway Company,
Township of Plains.

The Wilkes-Barre Connecting Railroad Company might prepare plans and estimates of cost for avoiding this grade crossing of the highway and street railway and endeavor to enter into an agreement with the parties in interest as to the proportion of the cost to be defrayed by each, and report to the Public Service Commission preliminary to a special hearing to be given in the case.

Oak Street Grade Crossing, Plains Township.

At Oak Street there are now 9 parallel tracks crossing Oak Street at grade. These tracks are used for storage and shipping purposes. The highway is a dirt road unimproved. It has the appearance of being little more than a lane, but the citizens of the township would remonstrate to the abandonment of this road. The grade of the tracks cannot be materially changed. The highway could be taken over by a bridge. The Wilkes-Barre Connecting Railroad will add two other tracks here and it is represented that there will be less obstruction to travel after the connecting railroad is built and operated at this point than now because there will be less switching back and forth over Oak Street. The township authorities do not ask for the abolition of the grade crossing, but they ask that it be properly protected by a light and by gates. The railroad company has expressed a willingness to do anything reasonable requested by the township authorities, and if possible an agreement in writing should be entered into by the two, and the same be filed in the office of the Public Service Commission for its approval.

Recommendations.

1. With respect to the Oak Street crossing in Plains Township, that the Wilkes-Barre Connecting Railroad Company and the Plains Township authorities be requested to enter into a written agreement, if possible, as to safety devices for the protection of the public at this grade crossing, and file the same in the office of The Public Service Commission for approval, or in lieu of it, the said railroad company be required to maintain gates at said crossing and to promptly light the same to the approval of the Commission. Furthermore, if at any time in the opinion of the Commission, the public convenience or necessity shall require the abolition of this grade crossing, then the Wilkes-Barre Connecting Railroad Company on order from the Public Service Commission, shall prepare plans and estimates of cost and suggestions as to the apportionment of said estimates of costs among the parties interested, and file the same with the Public Service Commission.

2. With respect to the proposed grade crossing at and near Mill Street in Miners Mills borough and Plains Township of Mill Street and the Wilkes-Barre Railway Company's trolley tracks by the proposed tracks of the Wilkes-Barre Connecting Railroad, that the proposed plans for said grade crossing be disapproved, and that the Wilkes-Barre Connecting Railroad Company be required to prepare plans and estimates of cost for avoiding said grade crossing of the highway and street railway, and endeavor to enter into an agreement, with the parties in interest, namely, Miners Mills borough, the township of Plains, the Wilkes-Barre Railway Company, the Lehigh Coal and Navigation Company, and the Central Railroad of New Jersey as to the proper apportionment of the cost of avoiding said grade crossing, and submit a report thereon, together with the plans, to the Public Service Commission as preliminary to a hearing or hearings to be given to all parties interested in the case, such report and plans to be filed not later than three months from the date of the order or permission.

3. That the written agreement between the Central Railroad Company of New Jersey, the Lehigh Coal and Navigation Company and the Wilkes-Barre Connecting Railroad Company relative to the construction of a portion of the said connecting railroad on the lands and right of way of the Lehigh and Susquehanna Railroad, including the so-called "Canal Branch" and for the avoidance of an existing grade crossing at or near the N. J. Healey's Breaker in Plains Township, etc., etc., copies of which are on file in the office of the Commission, be approved.

4. With respect to the crossing at grade by the tracks of the Wilkes-Barre and Eastern Railroad of the tracks of the Wilkes-Barre Connecting Railroad and the Delaware, Lackawanna and Western narrow gauge tracks as proposed, and the crossing at grade by the said narrow gauge railroad of the proposed track of the said Wilkes-Barre Connecting Railroad in Plains Township, that the plans be approved, and that the said connecting railroad company shall at its own cost and expense erect a tower and operate the same in connection with a system of interlocking signals for proper protection at the said crossings at grade. Plans and specifications for such safety protection to be prepared by the said connecting railroad company and to be submitted to and be approved, modified or amended by the Public Service Commission before final adoption and use by the Company.

5. With respect to the Main Street extension grade crossing in Plains Township and in connection therewith, the abandonment of an existing right of way at grade across the tracks of the Wilkes-Barre and Eastern Railroad by the substitution of a relocation paralleling the railroad and extending easterly to the said highway, that the plans be approved subject to the condition that the said Wilkes-Barre Connecting Railroad Company shall enter into a written agreement if possible, with Plains Township authorities relative to certain protective measures and safety devices to be provided by the said Railroad Company and file a copy thereof with the Public Service Commission for its approval; or in lieu of such agreement, that the said Railroad Company be required to properly light said crossing and to erect gates and operate and maintain them for the protection of the public at said crossing. Furthermore, that if at any time in the opinion of the Public Service Commission, the said grade crossing should be abolished, upon notice to this effect from the said Commission, said Railroad Company shall forthwith prepare plans and estimates of cost for such alteration or improvement and submit the same to the said Public Service Commission for approval, together with a report suggesting a proper apportionment of the costs among the parties interested.

6. With respect to proposed crossing above grade by the tracks of the Wilkes-Barre Connecting Railroad Company, the Wilkes-Barre and Eastern Railroad and the Delaware, Lackawanna and Western (narrow gauge), of the main line of the Lehigh Valley Railroad, Central Railroad of New Jersey (Canal Branch) and three breaker tracks of the Lehigh Valley Railroad Company in place of the existing crossing above grade at the same point in Plains Township of the tracks of the Wilkes-Barre and Eastern Railroad carried over on a single track bridge, that the general plans be approved as now filed in the office of the Public Service Commission, and that the Wilkes-Barre Connecting Railroad Company be required to file in the office of the said Commission detail plans of the abutments and piers and the superstructure proposed to be built with specifications therefor. The tracks supported by the bridge and for a suitable distance on either side shall be protected with guard rails.

7. With respect to the crossing above grade of River Street in Plains Township and the trolley line of the Wilkes-Barre Railway Company by the tracks of the Wilkes-Barre Connecting Railroad Company, the Wilkes-Barre and Eastern Railroad and the tracks of the Delaware, Lackawanna and Western (narrow gauge) in place of the existing crossing above grade of the Wilkes-Barre and Eastern Railroad, that the general plans on file in the office of the Public Service Commission be approved, that the Wilkes-Barre Connecting Railroad Company be required to file in the office of the said Commission detail plans of the proposed bridge and its supports with specifications therefor and that these plans and specifications shall provide for a tight bridge floor over the said highway or some proper protection of the highway underneath from material that might otherwise fall from the road-bed and tracks on the said highway. The tracks supported by the bridge and for a suitable distance on either side shall be protected with guard rails.

8. With respect to the crossing above grade of the tracks of the Lackawanna and Wyoming Valley Railroad (Laurel Line Electrical) and the standard gauge track of the Lehigh Valley Railroad (mine track) and the narrow gauge of the Lehigh Valley Railroad (mine track) in Plains Township, near the bank of the Susquehanna River, by the tracks of the Wilkes-Barre Connecting Railroad Company, the Wilkes-Barre and Eastern Railroad Company and the Delaware, Lackawanna and Western Railroad (narrow gauge) in place of the existing crossing above grade by the tracks of the Wilkes-Barre and Western Railroad, that the general plans on file in the office of the Public Service Commission be approved, that the Wilkes-Barre Connecting Railroad Company be required to file in the office of the said Commission detail plans of the proposed bridge and its supports with specifications therefor, and that the tracks supported by the bridge and for a suitable distance on either side shall be protected with guard rails.

9. With respect to the proposed bridge over the Susquehanna River and extending on to the flats in Dorranceton borough to carry the tracks of the Wilkes-Barre Connecting Railroad Company, the Wilkes-Barre and Eastern Railroad Company and the Delaware, Lackawanna and Western Railroad (narrow gauge) in place of the existing bridge that now supports the tracks of the Wilkes-Barre and Eastern Railroad, that the general plans on file in the office of the Public Service Commission be approved, that the Wilkes-Barre Connecting Railroad Company be required to file in the office of the said Commission detail plans of the proposed bridge and its supports with specifications therefor, these plans and specifications to include the approaches thereto with special reference to the approaches to be built or used by the said Wilkes-Barre and Eastern Railroad Company and the said Delaware, Lackawanna and Western Railroad (narrow gauge). The tracks supported by the bridge and on the approaches thereto and for a suitable distance on either side shall be protected with guard rails. In case of the improvement of navigation in the Susquehanna River by the State or Federal Government requiring a draw span or other change in the structure to facilitate navigation, the Wilkes-Barre Connecting Railroad Company shall first receive approval of the plans for such change, of the Public Service Commission, or shall make such changes as the said Public Service Commission may advise or approve.

10. With respect to the crossing above grade of Pierce Street and the trolley track of the Wilkes-Barre Railway Company in the borough of Dorranceton by the double track of the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the office of the Public Service Commission be approved, that the agreement providing that the crossing may be built as planned which has been executed by the said Wilkes-Barre Railway Company and possibly the said borough authorities, be made a matter of record in the office of the Public Service Commission by the filing of certified copies of said agreements, that the Wilkes-

Barre Connecting Railroad Company be required to file in the office of the said Commission detail plans of the proposed bridge and its supports with specifications therefor and that these plans and specifications shall provide for a tight bridge floor over said highway, or some proper protection of the highway underneath from material that might otherwise fall from the roadbed above. The tracks supported by the bridge and for a proper distance on either side shall be protected with guard rails.

11. With respect to the crossing above grade of Market Street and the trolley tracks of the Wilkes-Barre Railway Company in Dorranceton borough, by the double track of the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the office of the Public Service Commission be approved, that the agreement providing that the crossing may be built as planned which has been executed by the said Wilkes-Barre Railroad Company and possibly by the said borough authorities, be made a matter of record in the office of the Public Service Commission, by the filing of certified copies of said agreements, that the Wilkes-Barre Connecting Railroad Company be required to file in the office of the said Commission detail plans and specifications of the proposed bridge and its supports, and these plans and specifications shall provide for a tight bridge floor over said highway, or some proper protection of the highway underneath from material that might otherwise fall from the roadbed above. The tracks supported by the bridge and for a proper distance on either side shall be protected with guard rails.

12. With respect to the crossing above grade of Northampton Street, which is the boundary line between the boroughs of Dorranceton and Edwardsville by the double tracks of the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the said Public Service Commission be approved, that copies of any agreements that may have been executed between the said Connecting Railroad Company and the authorities of said borough providing for the construction of the crossing as proposed, be made a matter of record in the office of the said Public Service Commission by the filing of certified copies of such agreements in the office of said Commission, that the Wilkes-Barre Connecting Railroad be required to file in the office of the said Commission, detail plans and specifications of the proposed bridge and its supports, and that these plans and specifications shall provide for a tight bridge floor over said highway, or some proper protection of the highway underneath from material that might otherwise fall from the roadbed above. The tracks supported by the bridge and for a proper distance on either side shall be protected with guard rails.

13. With respect to the proposed bridge over the Susquehanna River and over the Riverside Boulevard in South Wilkes-Barre to carry the tracks of the Wilkes-Barre Connecting Railroad, that the general plans on file in the office of the Public Service Commission, be approved; that the Wilkes-Barre Connecting Railroad Company be required to file in the office of said Commission detail plans and specifications of the proposed bridge and its supports and that these plans and specifications shall provide for a tight bridge floor over the said Riverside Boulevard or some proper protection of the highway underneath from material that might otherwise fall from the roadbed above; the tracks supported by the bridge and for a proper distance on either side shall be provided with guard rails. In case of the improvement of navigation in the Susquehanna River by the State or Federal Government requiring a draw span or other change in the bridge to facilitate navigation, the Wilkes-Barre Connecting Railroad Company shall first receive approval of the plans for such a change of the Public Service Commission, or shall make such change as the said Public Service Commission may advise or approve.

14. With respect to the proposed relocation of Pickering Street in South Wilkes-Barre to avoid intersecting of West Academy and Birch Streets by the Wilkes-Barre

Connecting Railroad, that the general plans on file in the office of the Public Service Commission be approved, and that certified copies of the agreement between the city of Wilkes-Barre and the said Connecting Railway Company and the owners of the land effected shall be submitted to the Public Service Commission for approval and be approved, modified or amended by the said Commission before the work is done.

15. With respect to the proposed crossing of Miner Street and Maffet Street, or rather extensions of said streets west of Pickering Street in South Wilkes-Barre, either by embankment fill or by crossing above grade with bridges supporting three parallel tracks of the Wilkes-Barre Connecting Railroad Company, that before the work is done, and as soon as an agreement as to plans by which the work shall be done shall have been entered into between the said Wilkes-Barre Connecting Railroad Company, the city of Wilkes-Barre and the land owners affected, a copy of such agreement properly certified shall be submitted to the Public Service Commission for approval. Whatever the results of negotiations now going on as to plans by and between the said parties mentioned, the Wilkes-Barre Connecting Railroad Company shall do no work at and across the two said street extensions until detail plans thereof and specifications shall have been submitted to the Public Service Commission by the said Railroad Company and have been approved, modified or amended by said Commission.

16. With respect to the proposed crossing above grade of Amherst Avenue in South Wilkes-Barre by the three parallel tracks of the Wilkes-Barre Connecting Railroad, that the general plans on file in the office of the Public Service Commission be approved; that the said Wilkes-Barre Connecting Railroad be required to file in the office of the said Commission detail plans and specifications of the proposed bridge and its supports, and that these plans and specifications shall provide for a tight bridge floor over said highway, or some proper protection of the highway underneath from material that might otherwise fall from the road bed above. The tracks supported by the bridge and for a proper distance on either side shall be provided with guard rails. Any agreement that may be concluded between the said company and the city of Wilkes-Barre and the land owners affected which may relate to the plans by which said crossing of Amherst Avenue is to be constructed, shall be submitted to the Public Service Commission for approval and certified copies of any agreement already executed relative to this crossing shall be filed in the office of the said Commission.

17. With respect to the proposed crossing above grade of Marlborough Avenue in South Wilkes-Barre by the three parallel tracks of the Wilkes-Barre Connecting Railroad, that the general plans on file in the office of the Public Service Commission be approved; that the said Wilkes-Barre Connecting Railroad Company be required to file in the office of the said Commission detail plans and specifications of the present bridge and its support and that these plans and specifications shall provide for a tight bridge floor over said highway, or some proper protection of the highway underneath from material that might otherwise fall from the roadbed above. The tracks supported by the bridge and for a proper distance on either side shall be provided with guard rails. Any prior agreement or any agreement that may be concluded between the said company and the city of Wilkes-Barre and the land owners affected, which may relate to the plans by which said crossing of Marlborough Avenue is to be constructed, shall be submitted to the Public Service Commission for approval.

18. With respect to the proposed crossing above grade of the existing three parallel tracks of the Northern Coal and Iron Company's Plymouth Branch Railroad by the double tracks of the Wilkes-Barre Connecting Railroad Company in South

Wilkes-Barre; that the general plans on file in the office of the Public Service Commission be approved; that the said Wilkes-Barre Connecting Railroad Company be required to file in the office of said Commission, detail plans and specifications of the proposed bridge and its support. The tracks supported by the bridge and for a proper distance on either side shall be provided with guard rails.

19. With respect to the alteration of the existing above grade crossing of Dagobert Street in South Wilkes-Barre by the tracks of the Railroad of the Northern Coal and Iron Company (Buttonwood Branch), such alterations to consist of widening and raising the embankment approaches to the bridge and raising the bridge and laying thereon parallel tracks by the Wilkes-Barre Connecting Railroad Company, and the raising and widening and otherwise improving the existing piers and abutments to the overflow bridge adjacent to and northerly of Dagobert Street and to double track the road over said proposed bridge and its approaches, that the general plans on file in the office of the Public Service Commission be approved; that detail plans of the grade and abutments as they are to be built at Dagobert Street proposed to be built, shall be filed in the office of the Public Service Commission; by the said Wilkes-Barre Connecting Railroad Company and said Company shall provide proper protection of the highway at Dagobert Street from material that might otherwise fall upon the street from the railroad above. The tracks supported by the said Dagobert Street bridge and by the said overflow bridge and for a proper distance on either side of said bridges shall be protected with guard rails.

20. With respect to the alteration of existing above grade crossing of Horton Street in South Wilkes-Barre by the tracks of the railroad of the Northern Coal and Iron Company (Buttonwood Branch), such alterations to consist of widening and raising the embankment approaches to the bridge and raising the bridge and laying thereon parallel tracks by the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the office of the Public Service Commission be approved; that detail plans of the bridge and abutments as they are to be built at Horton Street shall be filed in the office of the Public Service Commission by the said Wilkes-Barre Connecting Railroad Company, and said Company shall provide proper protection at the highway at Horton Street from materials that might otherwise fall upon the street from the railroad above. The tracks on said bridge and for a proper distance on either side of said bridge shall be protected with guard rails.

21. With respect to the double tracking of the road bed and existing above grade crossing of Lawrence Street in South Wilkes-Barre by the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the office of the Public Service Commission be approved; that the said Connecting Railroad Company shall file in the office of the Public Service Commission detail plans of said bridge and its abutments, and said company shall provide proper protection of the highway at Lawrence Street from the railroad above. The tracks of said bridge and for a proper distance on either side of said bridge shall be provided with guard rails.

22. With respect to the double tracking of the roadbed and existing above grade crossing of Oak Street in South Wilkes-Barre by the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the office of the Public Service Commission be approved; that the said connecting Railroad Company shall file in the office of the said Public Service Commission detail plans of said bridge and its abutments, and said company shall provide proper protection of the highway at Oak Street from the railroad above. The tracks on said bridge and for a proper distance on either side of said bridge shall be provided with guard rails.

23. With respect to the double tracking of the roadbed and existing above grade crossing of Willow Street in South Wilkes-Barre by the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the office of the Public Service Commission, be approved; that the said Connecting Railroad Company shall file in the office of the Public Service Commission detail plans of said bridge and its abutments, and said company shall provide proper protection of the highway at Willow Street from material that might otherwise fall upon the street from the railroad above. The tracks on said bridge and for a proper distance on either side of said bridge shall be provided with guard rails.

24. With respect to the double tracking of the road bed and existing above grade crossing of Simpson Street in South Wilkes-Barre by the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the office of the Public Service Commission, be approved; that the said Connecting Railroad Company shall file in the office of the said Public Service Commission detail plans of said bridge and its supports, and said company shall provide proper protection of the highway at Simpson Street from material that might otherwise fall upon the street from the railroad above. The tracks on the said bridge and for a proper distance on either side of said bridge shall be provided with guard rails.

25. With respect to the double tracking of the roadbed and above grade crossing of Carey Avenue in Hanover Township by the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the office of the Public Service Commission, be approved; that the said Connecting Railroad Company shall file in the office of the Public Service Commission detail plans of said bridge and its supports and said company shall provide proper protection of the highway at Carey Avenue from material that might otherwise fall upon the avenue and tracks of the Wilkes-Barre Connecting Railroad Company from the railroad above. The tracks on said bridge and for a proper distance on either side of said bridge shall be provided with guard rails.

26. With respect to the proposed crossing at grade of the Plymouth Ferry Road by the existing tracks of the Buttonwood Branch of the Northern Coal and Iron Company and the proposed tracks of the Wilkes-Barre Connecting Railroad Company, that the general plans on file in the office of the Public Service Commission, be approved subject to the condition that the said Wilkes-Barre Connecting Railroad Company shall forthwith upon order by the Public Service Commission so to do, install, operate and maintain at said crossing such gates or other protective devices as the said Commission shall order or approve; and subject to such further conditions that if at any time in the opinion of the Public Service Commission the public convenience and necessity requires, that the said grade crossing shall be abolished, then upon notice to this effect from the said Commission, said Railroad Company shall forthwith prepare plans and estimates of cost for such alteration or improvement and submit the same to the said Public Service Commission for approval, together with a report suggesting a proper apportionment of the costs among the parties interested.

It is suggested that the Wilkes-Barre Connecting Railroad Company is required to furnish the Public Service Commission items of cost of each bridge and its abutments and piers and such other items of engineering cost as may be properly recorded in the office of the Public Service Commission for future reference.

Certificates of public convenience were issued by the Commission May 21st, 1914, subject to certain conditions appearing elsewhere in the report of the Commission, and substantially as stated above under recommendations.

9. WIRE CROSSINGS.

a—Lehigh Navigation Electric Company.

In this case the Lehigh Navigation Electric Company makes application for a Certificate of Public Convenience for an overhead crossing of the tracks and wires of the Slate Belt Electric Railway Company and the Pennsylvania Utilities Company near the village of Belfast in Plainfield Township, Northampton County. The Pennsylvania Utilities Company objects. The said Lehigh Company wishes to construct the crossing consisting of a 300 foot span supported by specially constructed towers at each end to carry high tension wires, the ground wires and telephone wires. The wire at the top of the towers is a 3-8" steel ground wire. Below the top wire are three 2-0 copper conductors on each side. Below and some 10 feet or more is the telephone wire. The details of the tower conform to the requirements of the specifications of the American Railway Association, and are of the same construction as the other towers of the Lehigh Company along the transmission line. The Lehigh Company claims that the 300 foot span is not a long one. There is on the same line a span 767 feet in length. As thus far constructed, the transmission line from Hauto has 21 crossing spans over railroads, telephone lines, transmission lines and trolley lines, the average span being 404 feet. The span lengths have been determined largely by the topography of the territory, and with the idea of obtaining sufficient vertical clearances. Thirteen of the crossings are over railroads, 5 over electric trolley lines and 3 over telephone and transmission lines.

The height of the lower wire at the proposed crossing, above the highest wire of the Pennsylvania Company is 17 feet 2 inches. The power wire of the Pennsylvania Company transmits 33,000 volts. The lower wire of the Lehigh Company is 22,000 voltage. The telephone wire is 7 feet above the ground wire of the Pennsylvania Company transmission line. It is claimed by the Lehigh Company that there is no likelihood or reasonable probability of any damage or danger being caused to the property of the Pennsylvania Utilities Company by the way and manner in which the proposed crossing is to be built. There are on the wooden pole lines of the Pennsylvania Company 6 conductors and 1 ground wire. There are on the Lehigh Company's line 6 conductors, 2 telephone wires and 1 ground wire.

The power station of the Lehigh Company is at Hauto, 36 miles west of the crossing in question. Martins Creek, the objective point of the line is 5 miles east of the proposed crossing. The main feeder at the said power station as constructed is stranded copper cable of 110,000 voltage. Some of the spans along this high transmission line of the said Lehigh Company are shown in the following table:

Over Easton, Pa., Railway trolley,.....	span 767 feet, voltage 110,000
Over Lehigh Valley Transit Co. trolley,.....	span 615 feet, voltage 110,000
Over Lehigh Valley Transit Co. trolley,	span 512 feet, voltage 110,000
Over Northampton Traction Co. trolley,.....	span 220 feet, voltage 222,000
Over Central R. R. of N. J. at Lehigh River,.....	span 275 feet.
Over D. L. & W. Crossing,.....	span 248 feet.
Over Central R. R. of N. J. near sub-station,.....	span 127 feet.
Over Lehigh Valley R. R. near river,.....	span 196 feet.

The minimum vertical distance between wires crossed is 7 feet.

With respect to the crossing in question, the Lehigh Company maintains that if the transmission wire should break it would fall, striking the one below it and cause short circuit. The circuit breakers would go out and thus shut off the power. The time limit relays at the station would open the circuit in perhaps 3 seconds, and this opening of the circuit breakers would not cause any damage.

It is the practice of the company to place the towers as close to the side of the road as practicable so as to shorten the span there. Usually long crossing spans are avoided. There is a 10 foot vertical space provided between wires transmitting 110,000 volts.

The wires at the crossing proposed are anchored dead ended on the suspension insulators, so that the approaching spans on each side, if the wires break, it will not affect the road span. The towers are self-supporting, in case all the wires break on one side they will take the entire strain of the pull. However, the length of the span is not the great factor, if proper clearance above the other wires is provided and not too great tension on the wires is assured, so the Lehigh Company asserts. The weight of wire is what causes the tension. So long as tension does not exceed a certain amount, it makes no difference what causes the weight or pull; but taken to its ultimate conclusion, the longer a wire span, the more likely it is to break. A 300 foot span in sleet storms will collect more weight and carry a greater load than a 50 foot span, and also wind load and resulting stresses are greatly increased the longer the span. It is not customary to build towers sufficiently high so that the lowest wire on them, if it were to break, will swing clear of the wires crossed below. The towers at the proposed crossing are the highest on the entire line. It is not feasible to put the wires at the proposed crossing under ground. A combination of overhead with occasional underground connections is accompanied with great difficulty in insulation.

From Hauto to Siegfried, where is the first substitution, the voltage line transmits 110,000 volts. From Siegfried east to a point north of Nazareth borough, which is not far distant from the crossing in question, the towers and cables have been put up in contemplation of a 110,000 volt transmission line at some future time. Beyond this point, the insulation is for 22,000 volts.

The said Pennsylvania Company looks upon Plainfield Township and other townships within a certain radius of Easton where its generating station is located, as its own preempted territory, and hence this case is one of peculiar concern to both competing companies, and really the gist of the matter is not so much with respect to the manner in which the physical crossing proposed shall be made, but one of greater significance. Shall the application be for a permit to construct a crossing, or shall it involve the question that lies behind it—whether the Lehigh Company has the right to cross the wires of the Pennsylvania Company in any manner, whatsoever?

The Lehigh Navigation Company was incorporated in April, 1911. Thirty-eight township companies covering Hauto in the anthracite coal region to Martins Creek on the Delaware River, where is located the Alpha Portland Cement Works, were incorporated, merged and consolidated into one company, December, 1912, so that the said Lehigh Company has the right to supply heat, light and power in Lower Mt. Bethel Township, Northampton County, where the Alpha Portland Cement Works are located, and in the other territory of the said townships. The Lehigh Company contracted with the Alpha Portland Cement Company to furnish power and built its line up to the proposed crossing and is ready for delivery of power, except for one missing link in the line, namely, at the point for which the crossing is now asked. The Lehigh Company maintains that it is absolutely essential that

the company shall have the privilege of constructing its line for the transmission of power, or it is impossible for it to fulfill the purposes for which the company was created. The Commission can compel the company to construct and extend its line to all parts of the territory it is authorized to serve. Hence, so the Lehigh Company maintains, the Certificate of Public Convenience asked for is precedent to commencement of service and it involves, therefore, simply the question of the physical crossing.

The said Lehigh Company argues that no electric light, heat and power company has an exclusive franchise such as the Pennsylvania Utilities Company. It may have exclusive right under contract, but no exclusive franchise in absence of such contract. Where the crossing is granted, the terms of the certificate of the Commission protect the company crossed and the public. The crossing shall be safe and in accordance with proper practice. Only the question of the making of the crossing is before the Commission. The purposes of the crossing is irrelevant. The Commission, so it is alleged by the Lehigh Company, cannot say to the operating company, "you cannot cross the line of another" because that is a power inherent in that company; but the Commission can say to the operating company, that the crossing proposed is not safe or convenient and that the crossing shall be built in such manner as it may prescribe. In other words, the crossing cannot be prevented, provided the petitioning company shall build it in such safe and proper manner as the Commission shall determine.

On the other hand, the Pennsylvania Company maintains that the object or purpose of the crossing must enter into the question to be considered by the Commission. The existing company with its wires already strung, can meet the demands of the territory it covers, and is subject to orders of the Commission for extension and regulation of service and rates. If a foreign company without any plant or facilities in the territory asks for permission to enter the territory, and in so doing, must cross the facilities of the existing company, it is essential that such petitioning company shall show the necessity for such crossing. The Commission is bound to consider the ultimate end, or object, or purpose.

The Certificate of Public Convenience has several meanings in the act. The Commission may go into the question sufficiently to find out whether there is a legitimate purpose behind the petition sufficient to justify the crossing. The question of safety in the manner of making the crossing is comparatively insignificant. Back and higher is the question of public interest. The consumer is the one who is weakest and needs most protection, for where competition leads to the duplication of plant and the multiplication of capitalization and divided territory, the public is bound to be subjected to rates and service that are ultimately unsatisfactory to all concerned. When a corporation is in possession of territory and has made large capital investments and has reasonably supplied the public with service, subject to the vicissitudes of ordinary business operations, the people on the whole are better served by one company under the prudent direction of the Commission, than under competitive conditions. The questions, therefore, for the Commission to consider are: What does the new company want? What is it trying to do?

So it appears that the opposition to the crossing by the Pennsylvania Utilities Company hinges upon the interpretation of the term "Certificate of Public Convenience" in the Public Service Company Law.

The Commission decided that its jurisdiction in this case relates to the construction and devices that shall be employed at the proposed crossing, in order to make the crossing safe to the public and protect the property of the companies crossed.

It was recommended:

1. The existing towers supporting the crossing-span proposed (they being denominated on the plan as Tower No. 19 and Tower No. 20), shall be moved eastward to within ten feet of the westerly line of the highway, and Tower No. 20 shall be moved westward to within ten feet of the easterly line of the highway, thereby providing for a horizontal clearance between the base of the said towers of approximately fifty-seven feet.

2. The said towers supporting the crossing-span shall be of such height as to give a vertical clearance of ten feet between the lowest wire of the Lehigh Navigation Electric Company's line, and the highest wire of the Pennsylvania Utilities Company's line, as it existed prior to January 25th, 1914, on or about which time two temporary poles were erected and wires were strung at said crossing by the Pennsylvania Utilities Company, which said wires are approximately on a level with and obstruct the crossing-span of the Lehigh Navigation Electric Company, hereby and herein approved, which said wires are to be taken down and replaced at the same level as they were prior to January 25th, 1914.

3. The adjoining span on each side of the crossing-span shall be in a straight line with said crossing-span, but on the line to the east and about half way between Tower No. 20 and Tower No. 21, shall be erected and maintained a flexible "A" frame tower, similar in design and construction to other flexible towers now installed along said line.

4. If at any time in the opinion of The Public Service Commission of the Commonwealth of Pennsylvania, it is desirable or necessary to raise the height of the towers, or to change the span, or to make any other alterations or improvements at or in connection with said modified crossing of the transmission lines of the Lehigh Navigation Electric Company with the transmission lines of the Pennsylvania Utilities Company, at the crossing hereby and herein approved, then the Lehigh Navigation Electric Company shall forthwith make such changes or improvements as The Public Service Commission of the Commonwealth of Pennsylvania may advise or approve.

b—Central Railroad of New Jersey.

In the matter of the application by the Pennsylvania Utilities Company for a permit to construct an overhead wire crossing over the tracks and railroad facilities of the Central Railroad of New Jersey at what was formerly Glendon, Palmer Township, and now is West Easton borough, Northampton County, the following report was made.

The Pennsylvania Utilities Company now operates and maintains a central station in the city of Easton for the purpose of generating electricity for light, heat and power, and is extending and improving this station and has constructed a high tension transmission line westerly along the river road for the purpose of supplying the public in Palmer Township and elsewhere. Just beyond the city line in the borough of West Easton, it is necessary to leave the said river road, which follows along the northern bank of the Lehigh River, and to cross the tracks of the Central Railroad of New Jersey which also parallels the said river, in order to reach the territory to the north that is to be served.

Somewhere in the valley it is necessary that a crossing shall be made of the tracks of the said railroad, otherwise the transmission line will be confined to the river bank. The Central Railroad of New Jersey has entered into an agreement with the said Pennsylvania Utilities Company relative to the manner in which the proposed crossing shall be constructed and maintained. The agreement is dated March 25th, 1914, and copies of it have been filed in the office of the Commission. It is stipulated in the agreement that the agreement shall not become effective until approved by the Public Service Commission.

The Central Railroad Company of New Jersey leases the tracks covered by the agreement in question of the Lehigh Coal and Navigation Company. The said navigation company owns a strip of land at the point of the proposed crossing 120 feet wide. This company has stated that the tracks, etc., leased to the Central Railroad Company of New Jersey are confined to an area 60 feet in width, leaving a strip on either side thereof, of approximately 30 feet, which are the private property of the said navigation company, to the same extent and with the same effect as if they were owned by an individual or corporation, because they were not included in the lease to the Central Railroad Company of New Jersey, and are not necessary for the operation of a railroad. Furthermore, the navigation company objects to the crossing of these two 30-foot strips, or did on April 20, 1914, in a communication addressed to the Secretary of the Commission.

On the ground at the site of the proposed crossing, the Pennsylvania Utilities Company has erected two steel towers, one on either side of the 120 foot strip of land, and that these towers are located on land owned by the said utilities company, or leased for right-of-way purposes. The hillside here is very steep. There is scant room. The highway stretches along the bank of the river, and in this road are the tracks of the Easton Transit Company which extend up stream a mile or so to Island Park. Abutting the highway is a strip of land about 100 feet wide occupied by dwellings. Then comes the 120 foot right of way of the railroad company. There are four parallel tracks here elevated approximately 30 feet above the level of the river road. Thence there is a precipitous hillside along the top of which there is a highway distant about 120 feet from the railroad location. This strip is so steep in slope that it remains unoccupied. The highway above, is approximately 100 feet above the level of the railroad tracks.

The Pennsylvania Utilities Company has erected a pole in the highway at the top of the hill. There is a span of 130 feet between this pole and the nearest steel tower. The span across the railroad tracks between the two steel towers is 138 feet in length. The span between the second steel tower and the pole erected on the utility company's land at the river road is about 100 feet. The two steel towers and the wooden poles next beyond them are in a straight line. There will be a vertical clearance of over 50 feet between the tracks of the railroad company and the lowest wire of the utilities company, and there will be a vertical clearance of about 18 feet between the wires of the said companies.

Along the river road are the poles and wires of the Bell Telephone Company, the Easton Transit Company and the Pennsylvania Utility Company. The poles and wires of the Bell Telephone Company are to be taken down and moved to the south bank of the river, in conformity with an agreement existing between the said telephone company and utilities company. Hence the present arrangement of these wires and poles need not be further discussed.

Recommendations.

It was recommended:

1. That the proposed crossing shall be constructed in conformity with the general plans and specifications accompanying the application for said crossing and on file in the office of The Public Service Commission of the Commonwealth of Pennsylvania, and, with respect to details, in conformity with the standard specifications for such crossings of the American Railway Association.

2. After the crossing shall have been constructed, the Pennsylvania Utilities Company shall, within 30 days, file in the office, of the said Public Service Commission, detail plans and a satisfactory description of the crossing as constructed and the connecting lines, poles and facilities for a distance of several hundred feet on either side of the said crossing.

3. If at any time, in the opinion of The Public Service Commission of the Commonwealth of Pennsylvania, it is desirable or necessary to make any alterations or improvements at or in connection with said crossing hereby and herein approved, then the Pennsylvania Utilities Company shall forthwith make such changes or improvements as the said Public Service Commission may advise, order or approve.

c—Raystown Water Power Company.

1—Williamsburg.

The Raystown Water Power Company purposes to build its line and to cross under the wires of the Penn Central Light and Power Company in Catharine Township, Blair County, at two points. In the report which follows, these crossings are designated as A and B. B is in the vicinity and near the old tow-path bridge over the Juniata River.

The Juniata River is the boundary line between Catharine Township to the north and Woodbury Township to the south. Williamsburg Borough is in the latter township. It is supplied with light by the Raystown Water Power Company. The Penn Central Light and Power Company has been erecting an auxilliary plant in Williamsburg for the purpose of a manufacture and sale of electric light and power to a district of considerable extent, in Blair and Huntingdon Counties and has in connection with this development constructed a high tension transmission line through Woodbury Township. It was the Company's intention to locate this line entirely south of the river; but failing to secure the necessary right of way at one farm, it was compelled to cross the river and to pass through a portion of Catharine Township for a distance of about seven hundred feet in length and thence by a second crossing of the river to enter Woodbury Township again. The first crossing designated as "A" is near the village of Ganister. Along the southerly bank of the river at this point are the tracks of the Pennsylvania Railroad and paralleling the said tracks is a public highway. The said transmission line of the Penn Central Company has been constructed over this highway and railroad and the river under an agreement specifying the form of construction of said crossing which form is in conformity with the general specifications of the Pennsylvania Railroad Company for all similar crossings.

The towers supporting the river span are made of steel. The one on the north bank is strengthened by proper construction, as shown in the photographs and plans filed with the Commission. This is made necessary because the alignment deflects to the right about thirty degrees at this point. The tower is located at the top of the old tow-path embankment and the lower wires (telephone wires) are 22' 6" from the surface of the ground.

Fifteen feet distant from this pole towards the river bank there was erected by the Raystown Company a wooden pole 30' high from the surface of the ground. At that point the ground is 9' lower than the top of the tow path where the Penn Central Company's pole is erected, hence the top of the 30' pole is 1' 6" lower than the telephone wires, or would be if the pole had not been cut down by the Penn Central Company. The Raystown Company was forced to seek this low land on the river bank because it was the only location where it could secure a right of way to cross the wires and facilities of the Penn Central Company.

After the pole was erected and equipped there was a ground wire at the top. The pole was chestnut 30' above ground and 5' underground, 8" diameter at the top. Four feet from the top was an arm supporting the conductor, and 4' below this arm was a second arm supporting two conductors spaced 7' apart and 2½' lower down was an arm supporting parallel telephone lines. The transmission line

was insulated for forty-five thousand volts. The line voltage at the present time will be twenty-three hundred. Owing to the difference in elevation of the ground at the base of the two poles, a man might stand on the edge of the tow-path and reach the nearest transmission line on the Raystown Company's pole with a rod 12' long.

Furthermore, this wooden pole is located where it may be damaged by a freshet and ice floe.

The Penn Central's tower should be elevated so as to give a vertical clearance between the lowest wire on its pole and the highest wire on the Raystown Company's pole of at least 8'. Still further, the steel tower should be moved over to the north so as to provide room for the erection of the pole and line of the Raystown Company on ground not subject to inundation; and finally, the Raystown Company should be required to conform its construction for transmission lines of forty-five thousand volts to the standard specifications set forth in the report of the joint committee on high tension crossings on the American Institute of Electrical Engineers.

These suggestions are all the more important since the crossing is to be a permanent one.

The Raystown Company's transmission line from Williamsburg passes westerly into Catharine Township. When the Joseph Winter farm was reached, passage across it was stopped because the Penn Central Company had acquired control of the farm. This company had also obtained control of a narrow strip of land for a mile or more to the north and also to the south of the river, effectually preventing the construction by the Raystown Company of its transmission line westward, with the exception of the right of way over the land of the Pennsylvania Railroad, a narrow strip bordering the river along the north bank. This right was secured by the Raystown Company. At crossing "b" the Penn Central Company has a tower erected on the river bank, and has strung its wires spanning the river, the lowest or telephone lines at the tower are 22' above the surface of the ground, which is low here and subject to flood in high water. This tower is of special construction as the alignment deflects on the right about 45 degrees. The pole nearest the river is directly at the bank. The Raystown Company proposes to erect its transmission pole on ground 8' lower which brings the location of it into the channel of the river. There will be a vertical clearance of 12' only between the transmission wire of the Raystown Company and the steel tower of the Penn Central Company. It is proposed by the Raystown Company to place the ground wire at the top of the pole and provide a vertical clearance between it and the telephone wires of the Penn Central Company of 8'. This will bring the three transmission wires to within 9' of the surface of the ground at the steel pole. About 100' up stream where the old bridge abutment was located and where the tow path embankment now exists, the pole to be erected there on the edge of the river channel will carry the transmission wire about level with the surface of the ground. To remedy this, the said embankment and tow-path bridge abutment should be removed in the vicinity and the ground leveled off, but even then the wires will be altogether too low.

The steel tower should be moved further back from the river and be carried up sufficiently high to afford 8' clearance of the nearest wire on the pole of the Raystown Company when this pole and its complement shall have been erected on ground away from the river channel and not subject to ordinary inundation. The form of construction to be adopted by the Raystown Company should be in conformity with the standard specifications hereinbefore mentioned.

Recommendations.

The two crossings "A" and "B" are unnecessary and they should be avoided. The Raystown Company is compelled to seek the banks of the river and to cross the lines of the Penn Central Company at two points when it wished to avoid altogether the line of the Penn Central Company and to pass up the valley many hundred feet to the north. There is nothing to hinder this avoidance of two crossings now except the wilfulness of the Penn Central Company. If it be made apparent to the Penn Central Company that the Raystown Company will be permitted to build its line westward up the valley of the Juniata, and that it will be a matter of economy for the Penn Central Company to permit the Raystown Company to pass up the valley with the transmission line at a point hundreds of feet north of the Penn Central Company's line in Catharine Township rather than to compel the Raystown Company to cross the wires of the Penn Central Company, possibly the difference may amicably be adjusted and the two needless crossings entirely avoided.

It is suggested that the Commission make an effort to bring about this result, or in lieu of it that the Raystown Water Power Company be required to change the location of its proposed line from the edge of the channel to the high ground, and to conform its construction to the standard specifications as reported by the joint committee on high tension crossings of the American Institute of Electrical Engineers, and file its plans for approval with the Commission.

Also that the Penn Central Company, in lieu of its granting a right of way across its other land to the Raystown Company, shall change the location of its towers at any of the river crossings in Catharine Township so as to permit the Raystown Water Power Company transmission line to be constructed along the tow-path in said territory according to location plans, approved by The Public Service Commission. Furthermore, the Penn Central Light and Power Company shall elevate its poles at the said crossings in conformity with plans to be approved by The Public Service Commission in order to give a clearance of 8' between its lowest wires and the highest wire of the Raystown Water Power Company line at the crossings proposed.

2—Mapleton.

The Penn Central Light and Power Company is a powerful corporation. Its main generating plant is located in the city of Altoona; another generating plant is located on the Juniata River at Warrior's Ridge. Here a dam has been constructed, and when there is sufficient water, the electric current is produced by water power. During seasons of drought the deficiency in current is made up by an auxiliary steam plant. The territory served by the Company is most extensive. It includes portions of Cambria, Indiana, Clearfield, Blair, Huntingdon, Mifflin and Juniata Counties. In Huntingdon County, on the Raystown Branch of the Juniata River, the Raystown Water Power Company has erected a large dam and generating station. This Company has also secured the right for the erection of two other dams on the same stream, which when built, will have developed the water power of this stream to its maximum capacity. The operations have been projected, and a plant has been erected thus far largely by local capital. The competition, particularly in Huntingdon and Blair Counties, between these two corporations is very keen.

At a point in Union Township, Huntingdon County, near the Borough of Mapleton, where the service line of the Penn Central Company, crossed the public road known as Hare's Valley Road (near the plant of the Pittsburgh White Sand Com-

pany) and also at a point where the Penn Central Light and Power Company service line crosses the aforesaid road (near the quarry of the Juniata White Sand Company) the Raystown Company proposes to build its line under the wires of the said Penn Central Light and Power Company.

The proposed line of the Raystown Water Power Company is to have a voltage of 2300. At each crossing there is to be a vertical clearance of 3 feet between the lowest wires on the pole of the Penn Central Company (which wires are parallel telephone lines), and the highest wire on the pole of the said Raystown Company. According to the plan there will be a vertical clearance between the lowest wire of the said Raystown Company and the surface of the ground of the proposed crossing, of twenty feet.

Recommendations.

(1) That the Raystown Water Power Company shall file a satisfactory plan and elevation of each crossing as constructed, showing the highway and property lines and poles and the lines of wires of the Penn Central Light and Power Company and the Raystown Water Power Company at and in the vicinity of each of the said crossings.

(2) That if, at any time, in the opinion of the Public Service Commission it is desirable that said crossings shall be changed, then upon order to make a change the Raystown Water Power Company shall forthwith comply with such order of The Public Service Commission.

3—Mount Union.

The Raystown Water Power Company proposes to build certain lines of wires in the Borough of Mt. Union, Huntingdon County, under the existing wires of the Penn Central Light and Power Company.

The Penn Central Light and Power Company's house service wires, distribution wires, steel light supporting arm and distribution wires, on or near the southern side of Shirley Street, at its intersection with Division Street north of Shirley Street, are to be crossed by the primary wire (2200 volts) and the secondary wires (one of 220 and one of 110 volts), of the Raystown Water Power Company, all three of said lines of the Raystown Company being supported on a single cross arm attached to a chestnut pole and providing a vertical clearance of not less than 3 feet between the lowest wires of the Penn Central Company and the said wires of the Raystown Company, and providing a vertical clearance of about 20 feet between said Raystown Company's wires and the surface of the street beneath.

On Small Alley east of Division Street on the north side are the poles of the Penn Central Company, and on the south side are the poles of the Postal or some other telegraph or telephone company. The poles of the Raystown Water Power Company cross the tracks of the Pennsylvania Railroad, and pass southerly along the easterly side of Division Street. There will be a crossing at the northeast corner of Division Street and said Small Alley of the wires of these two companies.

The Raystown Company's pole nearest the railroad is high, being made so in order to cross the said railroad tracks in conformity with the Pennsylvania Railroad Company's standard specifications. The line will have to be dropped at this pole, so as to pass under the wires of the Penn Central Company. From a pole to be erected on the southeast corner of the said Division Street and the Small Alley, thence the line proposed by the Raystown Company will extend easterly along the south side of the alley, passing under three (3) house service wires of

the Penn Central Company. In each case there is to be a vertical clearance of 3 feet between the wires of the Penn Central Company and the wires of the Raystown Company, and there will be about 20 feet vertical clearance between said Raystown Company's wires and the surface of the ground. There are to be three (3) wires on the pole of the Raystown Company, supported on one cross arm; they to be respectively 2300, 220 and 110 volts.

On Wood Street which runs north from Shirley Avenue, the Penn Central Company has a line of wires. The Raystown Company proposes to construct its wires of the same voltage and arrangement as hereinbefore described under the wires of the Penn Central Light and Power Company, so as to give a vertical clearance of three (3) feet between the secondary lines of the Penn Central Light and Power Company and the wires of the Raystown Company, and so as to give a vertical clearance of the latter from the surface of the road, of about 20 feet. Wood Street is in the outskirts and it is not so much travelled or built up.

The Penn Central Company has a line of wires on the east side of Jefferson Street. The Raystown Company purposes to construct a line southerly along Academy Alley, crossing over the wires of the Penn Central Company at Jefferson Street, so as to give a vertical clearance of three (3) feet. On the pole of the said Penn Central Company there are to be three wires supported on one arm, as hereinbefore described. In the same alley are two lines of telephone and telegraph poles, supporting many lines of wire, but they are on higher poles and are carried high over all other wires.

Jefferson Street runs north and south and is a thoroughfare thoroughly built up. Along the east side, the Penn Central Company has a line of poles supporting primary and secondary wires. The secondary wires are twenty feet six inches above the surface of the street. The Raystown proposes to pass under the secondary wires with a clearance of twelve inches only, as shown on the original plan filed with the application but now modified to give a clearance of twenty-four inches. There is a house service wire passing obliquely across Jefferson Street here. The wires of the Raystown Company are to pass over the service wires with a clearance of eighteen inches. In the alley west of Jefferson Street the Penn Central Company has a service wire over which the wires of the Raystown Company will pass with a clearance of from two (2) to four (4) feet, and in the alley east of Jefferson Street the Penn Central Company has a house service wire over which the Raystown Company's wires will pass with a clearance of two (2) feet.

If the pole of the Raystown Company that is to be erected at the southwest corner of Jefferson Street and the alley were to be used by the Penn Central Company for its house service wires, then it would be possible to secure a clearance of three (3) feet between the wires of the two companies, but the wires of the Raystown Company would then come within seventeen (17) feet from the surface below.

Discussion.

Three (3) feet clearance of low tension wires may be permissible when unavoidable, but it is preferable to have more when the wires belong to different companies. It may be that later the Public Service Commission will work out a standard specification for low tension as well as high tension crossings. Therefore it may be well to consider these proposed crossings in the Borough of Mt. Union in the light of temporary crossings, and especially those at and in the vicinity of Jefferson Street and the alley. At Jefferson Street the Company may be permitted temporarily to carry its line across the street with a vertical clearance of not less than 17 feet between the surface of the street and said wires, and with a vertical clearance between its wires and those of the other company of not less than three (3) feet.

Recommendations.

(1) That the Raystown Water Power Company shall file a satisfactory plan and elevation of each crossing as constructed, showing the lines of the streets and alleys and the poles and the lines of wires of all utility companies at or in the vicinity of each of the said crossings.

(2) There shall be a vertical clearance between the wires of the Raystown Water Power Company and the wires of the Penn Central Light and Power Company, or those of any other company at said crossings, of at least 3 feet, and with the exception of the crossing at Jefferson Street and a small alley, the clearance between the wires of the Raystown Company and the surface of the street shall not be less than 20 feet.

(3) At the proposed crossing of Jefferson Street and the small alley the wires of the Raystown Water Power Company shall have a clearance above the surface of not less than 17 feet, and the said Raystown Water Power Company may, if it so elect, prepare a plan for the joint use by it and the said Penn Central Light and Power Company, whereby the surface wires of the said Penn Central Company shall be attached to the pole of the Raystown Water Power Company, in order to give the necessary clearance specified and upon arrival of this plan, the Public Service Commission may order such joint use of said pole.

(4) The said crossings hereby and herein approved as to form of construction shall be considered temporary as to form, construction and clearance, and if at any time in the opinion of The Public Service Commission it is desired or necessary that said crossings shall be changed in form of construction or clearance, then upon order to make a change therein the Raystown Water Power Company shall forthwith comply with such order of the Public Service Commission.

4—Petersburg.

Porter Township is northwest of Huntingdon Borough and is bounded on the west by the Juniata River. Near Petersburg Borough is the mouth of the Frankstown Branch of the river that comes in from the west and up this branch valley on the Petersburg Cut-off of the Pennsylvania Railroad there is a station called Alferata. Near this station, along the southern bank of the Frankstown Branch of the Juniata River, the Penn Central Light and Power Company has erected its high tension towers and lines. Steel towers have been built, 6-45000 volts high tension wires in two series of three each have been strung, also 3-1100 volt wires and two telephone lines.

Between towers 94 and 95 of said Penn Central Company, where the tramway of the Federal Refractories Company crosses under said Company's line of wires and northerly across the Branch River, which bridge is about 1000 feet west of Alferata Station, it is proposed by the Raystown Water Power Company to erect its poles and transmission lines and pass under and across the right of way and wires and facilities of the said Penn Central Light and Power Company, the said proposed crossing being nearly perpendicular to the line of wires of the Penn Central Company, pole C of the Raystown Company to be attached to a pier of the bridge sustaining the tramway across the river, and pole B to be erected at the other end of the span which is to cross under the said Penn Central line; thence from pole B the line is to deflect nearly perpendicularly and to pass westward paralleling the Penn Central line to pole A, which is to be 125 feet distant from pole B. Hence pole B is to be a pivotal structure and in order to make it rigid, requires a special form of construction.

The Bureau conferred with the representatives of the Raystown Company and of the Penn Central Company, and brought about an agreement with the following recommendations as to the form of construction to be adopted:—

Recommendations.

1. Pole "B" of the Raystown Water Power Company—the pivot pole and the one to sustain the south end of the crossing span proposed, should be built as a double pole and be constructed, in all respects, similar to the standard practice for such poles similarly located, of the Pennsylvania Railroad Company; and this shall apply also in so far as such standard practice is applicable thereto, to poles "C" and "A" and their wiring and appurtenances.

2. The highest wire of the Raystown Water Power Company at the proposed crossing shall be so constructed as to provide a clearance of not less than 8 feet beneath the lowest wire of the Penn Central Company line, this clearance referring to the transmission wires of said companies. The Raystown Water Power Company shall place guard wires at least 5 feet under the wires that are lowest on the Penn Central Light and Power Company's lines, and these guard wires shall be at least 3 feet above the highest wires of the said Raystown Company, at the said proposed crossing, and support and properly ground the said guard wires at either end of the said crossing span, in conformity with standard practice for guard crossings of this kind.

3. If at any time, in the opinion of the Public Service Commission, it is desirable that said crossing shall be changed, altered or improved, the Raystown Water Power Company shall forthwith comply with such order of the Public Service Commission.

4. The Raystown Water Power Company shall, after having constructed the crossing herein and hereby approved, and in the manner herein provided for prepare a satisfactory plan and elevation in detail of the crossing as constructed, and of the rights-of-way, property lines and facilities of the Penn Central Light and Power Company at and in the vicinity of the crossing, together with a description thereof sufficient to enable the Public Service Commission to determine whether the Raystown Water Power Company has built the crossing as ordered.

d—Standardization of Overhead Wire Construction.

There are hundreds of thousands of wire crossings in Pennsylvania. The Public Service Company Law places in the hands of the Public Service Commission the matter of regulating crossings of this kind and the joint use of poles. Evidently the law did not contemplate particular action by the Commission on every crossing constructed. Such attention would be impracticable. It would delay rather than enhance public service and convenience and as evidence of this, reference may be had to Section 12 of Article 5 of the law.

"It shall be proper, however, for the Commission, by general rule or order, whenever the same can be properly regulated by suitable general rule, to prescribe the terms and conditions under which such crossing may be constructed, operated, maintained or protected, without the particular approval of the Commission."

It became evident early in the operations of the Bureau, that the Commission could advisedly proceed under this provision of the law. It has been ascertained by a field investigation and otherwise, that there is a wide variance of opinion held by those interested and concerned in the construction of telephone and telegraph lines, railroad, signal and overhead lines, street railway power and operating

lines and the lines and facilities of electric light and power companies. There is at the present time a large amount of construction that is not in conformity with accepted good practice. The question of responsibility enters as an important element into the conduct of affairs of companies using overhead line construction. If a standard of practice covering these fields of endeavor could be worked out and adopted, it would reduce to a small minimum disputed cases which would have to come before the Commission for its consideration and action. Consequently the Commission decided that the chief of the Bureau of Engineering should look into the problem. With the knowledge and consent of the Commission, the said chief is taking the requisite steps to bring about the appointment of committees of the State associations concerned in wire crossings, for the purpose of meeting in joint convention to discuss the subject, and for the further purpose of working out rules of standard practice to be laid before the Commission for its consideration.

10—ADMINISTRATION OF SERVICE RULES AND REGULATIONS.

Facilities and Organization Projected for the Administration of the Service Rules and Regulations Adopted by the Commission.

Arrangement.

- 1—General Obligations Imposed.
- 2—Facilities and Organizations Required.
- 3—Apparatus Purchased for Use in this Work.
- 4—Meter Prover Tests.
- 5—Plan of Survey of Conditions Existing in the Utilities.
- 6—Report Forms Developed for Use in Survey.
 - (a) Inspection Report, Electric Utilities.
 - (b) Inspection Report, Gas Utilities.
 - (c) Inspection Report, Water Utilities.
 - (d) Inspection Report, Heating Utilities.

General Obligations Imposed.

The adoption by the Commission of the Rules and Regulations discussed in the preceding sections imposed upon the Commission, and hence upon its Engineering Bureau, the obligation to inspect, for approval or otherwise, the standards and the testing facilities used by the utilities in connection with the testing of service meters and the maintenance of the quality of the product. The Rules further impose upon the Bureau the work of calibrating or standardizing certain of these standards, and certifying to their correctness by appropriate certificates or seals,

and further specify January 1st, 1915, as the date after which tests made with uncertified standards will not be considered authoritative. A third obligation imposed by the Rules and Regulations adopted by the Commission has to do with the maintenance by the utilities operating and service records. Although the requirements are less specific than in the case of the other two obligations, it is nevertheless incumbent upon the Bureau to ensure the presence in the records of the Utilities in easily available form, of the information specified by the Rules and Regulations of the Commission.

Facilities and Organization Required.

In order to meet the above obligations, laboratory facilities, a trained laboratory force, a trained field force, and a supervising and directing force are necessary. It was thought wise to proceed cautiously in the equipment of laboratories and the organization of a force, as there was some uncertainty concerning the volume of work to be handled, and concerning the dividing line between field work and laboratory work, particularly in the case of gas and water utilities, and it was felt that by proceeding slowly, the real needs of the situation would soon become apparent. Another very important factor demanding consideration at this time was the smallness of the funds available for equipment and for an organization to carry on the work. In accordance with the above reasoning, it was planned to establish temporary standardizing laboratories in the Engineering Schools of the University of Pennsylvania, Philadelphia, Pa., and the University of Pittsburgh, Pittsburgh, Pa. The facilities available in the laboratories of these schools are such that a very moderate outlay for special equipment would enable the work of the Commission to be carried on satisfactorily until such time as funds were available for the establishment of a laboratory belonging to the Commission. Most of the actual work in connection with these laboratories would be done by experienced members of the teaching staffs, under the supervision of the Consulting Engineers of the Commission, Prof. R. H. Fernald, of the University of Pennsylvania, and Prof. L. H. Harris, of the University of Pittsburgh. The instructors would naturally be paid for their services, but the arrangement would avoid the expense of immediately appointing a full time organization.

It was planned to have the gas meter provers and the gas calorimeters standardized in the field, although this was subsequently modified to the extent of arranging for the calorimeter standardization as laboratory work. It was further decided that the development of the above plans would be aided materially by having available the general information obtained from a survey of conditions existing in the electric, gas, water and heating utilities, with particular reference to items of interest in connection with the Rules and Regulations adopted by the Commission.

Apparatus Purchased.

The following apparatus was purchased for the use of the Bureau in carrying out this work.

(A) 1 1-cubic foot bottle, immersion type, made by the American Meter Company, and certified by the United States Bureau of Standards.

(Used by the Inspector of Meter Provers in testing gas meter provers belonging to, and in use by the utilities.)

(B) 1 Improved Junkers Calorimeter and accessories, made by Junkers & Company, Dassan, Germany, and certified by the United States Bureau of Standards.

(For use in testing the heat value of gas and as a primary standard for the testing of calorimeters belonging to the gas utilities.)

(C) Miscellaneous apparatus for general use in connection with the above equipment and general testing and inspection work.

1—5" Aneroid Barometer.

1—U. S. Weather Bureau Type Sling Psychrometer.

2—Stop watches.

2—Test Thermometers.

1—50 lb. U. S. Standard Test Weight.

1—Special 3' Steel Scale.

Meter Prover Tests.

Mr. A. C. Gumbert, of Pittsburgh, Pa., was appointed Inspector of Meter Provers, and on receipt of the Cubic Foot Bottle spent considerable time in the meter shop of the Equitable Gas Company at Pittsburgh, experimenting with the bottle and its application to prover testing in the field. No further field testing was done, as Mr. Gumbert was taken from this assignment and placed on some investigations connected with the "Full Crew Law."

Plan of Survey.

The chief purpose of the proposed survey was to examine the standards and the testing facilities maintained by the utilities, their use of the same, the nature and adequacy of their records covering the various items specified in the Rules and Regulations of the Commission, and to make recommendations to the Commission concerning the approval of any or all of these items. The inspections necessary to obtain the above information would afford opportunities for placing the Commission and the utilities in closer relation with one another, clarify ideas and concepts for both parties, and offering the representative of the Commission opportunities to be of service to the utilities.

For the purpose of making the survey of conditions existing in the electrical field, the Commission engaged the services, during the summer months, of Prof. L. H. Harris, of the Electrical Engineering School of the University of Pittsburgh, and for making the survey in the field of Gas, Water and Heating Utilities, engaged the services, for a similar period, of Prof. H. E. Ehlers, of the Mechanical Engineering School of the University of Pennsylvania. Prof. Harris had taken an active part in the formation of the Rules and Regulations, and Prof. Ehlers, through his association with Prof. R. H. Fernald, was in close touch with the situation. Professors Harris and Ehlers started their preliminary work of planning the survey, its purpose, its scope, its methods, forms, etc., on June 18th, 1914, and on June 25th, 1914, made their first field inspections in Chester, Pa.

The scope of the electric survey was planned to embrace all companies operating in towns of 10,000 population and over, and an itinerary was mapped out on this basis, using the McGraw Directory as a guide. In view of the better gas records available in the Bureau at the time of planning the survey, it was decided to map out an itinerary covering all gas utilities whose yearly output exceeded 20,000,000 cubic feet, and to inspect as many water and heating utilities as time and circumstances would permit. It was further decided to begin with the artificial gas utilities in the eastern and central portions of the State, covering the water and heating utilities in the towns visited whenever possible.

Report Forms Developed for Use in Survey.

The following forms were developed for use in obtaining and recording the specific information desired. In addition to filling in these form notes, general notes relating to the utility being inspected and to local conditions of interest were submitted, together with specific recommendations covering the approval or otherwise by the Commission of the testing facilities, records and practices of the utility. These detailed reports, covering the six (6) electric, one (1) water, eight (8) gas and one (1) heating utilities inspected prior to July 1st, 1914, are on file in the Bureau of Engineering.

Inspection Report, Electric Service Utilities.

THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA.—INSPECTION REPORT ON ELECTRIC SER- VICE UTILITY.—GENERAL INFORMATION.

Date of Inspection:

GENERAL.

Name of Utility.....

Location of Office.....

Information furnished by.....

Nature of service.....

Extent of territory and population served.....

.....

Generating stations. (Location, capacity, etc.).....

.....

What graphic recording meters are connected in each generating station.....

.....

Are the charts kept?.....

Are there graphic recording volt meters connected at points distant from the generating stations or sub-stations?.....

.....

What voltage regulating apparatus, automatic or otherwise, is provided at the generating stations or sub-stations?.....

.....

Is a generating log kept?.....How often are readings taken?.....

.....

Is a record kept of the time of switching on and off all street lighting circuits?.....

.....

Is a record kept of interruptions to service?.....

.....

Is a record kept of all complaints and the action thereon?.....

.....

.....

What is the scope and frequency of inspections?.....

 Is any report of inspections made, or record kept?.....

METER TESTING RECORDS.

Number of consumers?.....Number of meters?.....
 Is a meter record kept?.....
 Does the record show all information called for in Rule XIII?.....

 General arrangement of apparatus and methods of testing?.....

 Primary standards?

Secondary standards or check meters:

Make	Type	Serial	Volts	Amperes	Frequency
.....
.....
.....

Rotating Standards:

Make	Type	Serial	Volts	Amperes	Frequency
.....
.....
.....
.....
.....
.....
.....
.....
.....

Notes:

Note:—In case the records are not kept as specified in Rule X, note the place where these records may be found.

*Inspection Report, Gas Service Utility.*THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF
PENNSYLVANIA.

INSPECTION REPORT ON GAS SERVICE UTILITY.

GENERAL INFORMATION.

Date of inspection.....

Name of utility:

Location of office:.....

Name and official title of representatives from whom information was obtained:

Nature of service: Artificial Natural Domestic Industrial

Extent of territory served:

Number of meters in service: Positive Proportional Orifice

Location of plant:

Location of testing equipment:

STANDARDS, TESTING FACILITIES AND RECORDS.

Meter Testing Equipment:

Number of provers in use:

Makes, sizes and makers' numbers:

General arrangement:

General condition of apparatus:

Character of testing work:

Meter Test Records:

Do they give the identification of the meter?.....The reason for making the test?The reading of the meter before being disturbed?.....The accuracy of the meter?.....All data taken at test?.....Do they permit the checking of the result?.....Nature of record?.....Where filed?.....

Meter History Records:

Numerically arranged?.....Do they give date of purchase?.....Name of manufacturer?Size?Identification?Various places of installation?Dates of installation and removal?Dates and general results of tests?..... Nature of records?.....

Allowable error on meters, if less than the requirements?.....

Periodical tests of meters, if more frequent than the requirements?

Installation of Meters:

Who inspects the installation of a meter?.....Is a record kept of the inspection?.....Of the time of previous test of meter?.....

Meters in Service Without Test Record:

Is positive provision being made for testing them within the periods specified by the requirements?.....How?

Request Tests and Records:

General method of handling request tests?.....

Is meter sealed before removal?.....Is a report of test issued to consumer?.....Is a report of test kept on file?.....Where?.....

Calorimeter Equipment:

Calorimeter—make?Maker's Number?.....

Meter—make?Maker's Number?.....

Thermometers—graduations?Calibrated?.....

Water measurement—graduate?.....Scales?.....Range?

Least Count?

General arrangement of apparatus?.....

General condition of apparatus?.....

Where is calorimeter set up?.....

Distance of point of sampling from station governor?.....

Frequency of tests?.....Nature of test records?.....

Do they give all data?.....Where filed?.....

Monthly average B. T. U.?.....

Character of testing work?.....

Pressure Measurements:

Recording gauges in service: H. P. distribution system?.....L. P. System?.....

Distribution of gauges on systems?.....

Nature of records and where filed?.....

Periodic surveys: Number and approximate locations of gauges used?.....

Frequency of surveys?.....Nature of record and where filed?.....

Approximate distribution pressures: Minimum?.....Maximum?.....Average?....

Sulphur Content:

Method of test?Frequency of test?.....

Where tested?Nature of record?.....

Service Interruption Record:

Does it give time of interruptions?.....Cause?Extent?.....

Duration?

General nature of record?.....On file at?.....

Complaint Records:

Does record give name and address of complainant?.....Date and nature of
 complaint?.....Action taken?Date of final
 disposition?General nature of record?
 On file at?.....

Inspection of Equipment:

How often made??.....Are records kept on file and where?.....

Accidents:

Where are records of accidents kept on file?.....

RECOMMENDATIONS CONCERNING APPROVAL:

Mr. F. Herbert Snow,
 Chief, Bureau of Engineering.

Dear Sir:

As a result of the inspection reported above, the following recommendations are
 made:

.....

Report forwarded—

Date.....

Inspector.

Inspection Report, Water Service Utility.

THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF
 PENNSYLVANIA.

INSPECTION REPORT OF WATER SERVICE UTILITY.

GENERAL INFORMATION.

Date of Inspection.....

Name of utility

Name and official title of representatives from whom information was obtained

Nature of service.....Number of meters in service.....

Extent of territory served:

Location of plant

Location of testing equipment.....

STANDARDS AND TESTING FACILITIES.

Water Meter Testing Equipment:

General nature and arrangement of equipment.....

 General condition of apparatus

 Character of testing work

 Remarks

RECORDS.

Meter Test Records:

Do they give the identification of the meter?.....The reason for making the
 test?.....The reading of the meter before being disturbed?.....
 The accuracy of the meter?.....All data taken at test?.....Do they
 permit the checking of the results?.....Nature of record?.....
 Where filed?

Meter History Records:

Numerically arranged?.....Do they give date of purchase?.....
 Name of manufacturer?.....Size?.....Identification?.....
 Various places of installation?.....Dates of installation and removal?
Dates and general results of tests?..... Nature of
 record?

Allowable error on meters, if less than the requirements?.....

Periodic tests on meters, if more frequent than the requirements?.....

Installation of Meters:

Who inspects the installation of a meter?.....Is a record kept of the
 inspection?.....Of the time of previous test of meter?.....

Meters in Service Without Test Record:

Is positive provision being made for testing them within the periods specified
 by the requirements?.....How?.....

Request Tests and Records:

General method of handling request tests?.....

Is meter sealed before removal?.....Is a report of test issued to con-
 sumer?.....Is a report of test kept on file?..... Where?.....

Service Interruption Records:

Does it give time of interruption?.....Cause?.....Extent?.....
 Duration?

General nature of record?.....On file at....

Complaint Records:

Does record give name and address of complainant?.....Date and nature
 of complaint?.....Action taken?.....Date of final
 disposition?.....General nature of record?.....

Inspection of Equipment:

How often made?.....Are records kept on file?.....
 And where?

Accidents:

Where are records of accidents kept on file?.....

RECOMMENDATIONS CONCERNING APPROVAL.

Mr. F. Herbert Snow,
 Chief, Bureau of Engineering,

Dear Sir:—

As a result of the inspection reported above, the following recommendations
 are made:

.....

Report forwarded:

Date..... Inspector.

Inspection Report, Heating Service Utility.

THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF
 PENNSYLVANIA.

INSPECTION REPORT OF HEATING SERVICE UTILITY.

GENERAL INFORMATION.

Date of Inspection.....

Name of utility

Location of Office

Name and official title of representatives from whom information was obtained

Nature of service.....Number of meters in service.....
 Extent of territory served:

 Location of plant
 Location of testing equipment.....

STANDARDS AND TESTING FACILITIES.

Hot Water or Condensation Meter Testing Equipment:

General nature and arrangement of equipment.....

 General condition of apparatus.....

 Remarks

RECORDS.

Meter Test Records:

Do they give the identification of the meter?.....The reason for making the
 test?.....The reading of the meter before being disturbed?.....
 The accuracy of the meter?.....All data taken at test?.....Do they
 permit the checking of the results?.....Nature of record?.....
 Where filed?.....

Meter History Records:

Numerically arranged?.....Do they give date of purchase?.....
 Name of manufacturer?.....Size?.....Various places of in-
 stallation?.....Dates of installation and removal?.....Dates
 and general results of tests?.....Nature of record?.....

Allowable error on meters, if less than the requirements?.....
 Periodic tests of meters, if more frequent than the requirements?.....

Installation of Meters:

Who inspects the installation of a meter?.....Is a record kept of the
 inspection?.....Of the time of previous test of meter?.....

Meters in Service Without Test Record:

Is positive provision being made for testing them within the periods specified by
 the requirements?.....How?.....

Request Tests and Records:

General method of handling request tests?.....

Is meter sealed before removal?.....Is a report of test issued to con-
 sumer?.....Is a report of test kept on file?.....Where?.....

Service Interruption Record:

Does it give time of interruptions?.....Cause?.....Extent?.....
 Duration?

General Nature of Record?.....On file at?.....

Complaint Records:

Does record give name and address of complainant?.....Date and nature
 of complaint?.....Action taken?.....Date of final disposi-
 tion?.....General nature of record?.....
 On file at?

Inspection of Equipment:

How often made?.....Are records kept on file?.....
 And where?.....

Accidents:

Where are records of accidents kept on file?.....

RECOMMENDATIONS CONCERNING APPROVAL.

Mr. F. Herbert Snow,
 Chief, Bureau of Engineering,

Dear Sir:—

As a result of the inspection reported above, the following recommendations
 are made:

.....

Report forwarded:

Date.....

Inspector.

PART THREE

RULES AND REGULATIONS PERTAINING TO ELECTRIC, GAS, HEATING AND WATER SERVICE UTILITIES.

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PART THREE

RULES AND REGULATIONS PERTAINING TO ELECTRIC, GAS, HEATING AND WATER SERVICE UTILITIES.

1—EXPLANATORY.

The work of preparing the Rules and Regulations adopted on April 9, 1914, by The Public Service Commission of the Commonwealth of Pennsylvania, pertaining to electric, gas, heating and water service utilities was performed previous to the establishment of the Bureau of Engineering.

Prof. R. H. Fernald, University of Pennsylvania, and Prof. L. H. Harris, of the University of Pittsburgh, were engaged to study this problem and to frame rules and regulations under the supervision of Commissioner Tone. During the progress of the work, hearings were given to which representatives of the utilities were invited to be present.

The Rules and Regulations as adopted were divided into two parts. The first part deals with those general features of operation which go to make up "service." The second part deals with meters and meter testing.

The purpose of the first part of these Rules and Regulations was to place before the operators information as to what would ordinarily be considered good practice, or in terms of the act "reasonably adequate" service. The purpose of the second part of these Rules and Regulations was more specific, and in this part is made an effort to define the requirements in such terms that they may be quite readily followed by all operating Public Service Companies affected.

Every consumer who buys service by meter is affected by these rules. The practice of the operating company in this regard is, therefore, of importance to every consumer, and should in every case be satisfactory to the Commission, and under the rules as adopted must be satisfactory to and be approved by the Commission.

In the said preparation of the rules for the regulation of the four public utilities mentioned, the guiding principle was that of fair treatment for both the public served by the utility and the utility itself. It was realized that the stringent regulations that might be consistently met by certain large companies in the larger cities might prove absolutely prohibitive when imposed upon the smaller communities of the State with their limited backing. So it was felt, in order to be fair, that on the one hand, the rules should impose high standards of quality of the commodity furnished, and of service rendered, and on the other hand, they should impose no undue hardships upon the smaller utilities.

Any rules or regulations that place excessive demands upon a utility result in increased expense, and any increase in the cost of manufacture of distribution must ultimately be borne by the public. It is, however, but consistent that the prices charged shall warrant adequate and satisfactory service, and shall allow a fair return on the invested capital. An increase in price with no apparent betterment of service or of the quality of the commodity delivered, makes trouble.

It was also regarded important that although the requirements be rigid, they should not be so rigid as to prohibit the possibility of their enforcement.

From utilities furnishing electric, gas, heat or water service, the public has the right to expect—

- 1—A commodity of good and reasonably uniform quality.
- 2—Satisfactory and reasonable uniform pressure.
- 3—Correct appliances for measuring the amount of the commodity used by each customer.
- 4—Freedom from interruptions to service and avoidance of accidents.
- 5—Reasonable prices for the service rendered.
- 6—Proper distribution and readiness to serve all communities within the natural territory supplied by the utility.

2—ELECTRIC UTILITIES.

Circular No. 10—A.

RULES AND REGULATIONS.

Adopted April 9, 1914.

THE PUBLIC SERVICE COMMISSION
of the
COMMONWEALTH OF PENNSYLVANIA.

Part I.

GENERAL.

Definition:

The term "utility" as used in these rules includes all public service companies, corporations and persons, as defined in The Service Company Law, engaged in the production, sale or distribution of electricity within the jurisdiction of the Commission.

I.—Statutory:

"It shall be the duty of every public service company to furnish and maintain such service, including facilities, as shall in all respects be just, reasonably adequate, and practically sufficient for the accommodation and safety of its patrons, employees, and the public, and in conformity with such reasonable regulations or orders as may be made by the Commission."

II.—Voltage Variation:

Each utility supplying electrical energy from a constant voltage system, shall adopt standard service voltage for such system, the suitability and adequacy of which voltages may be determined at any time by the Commission, and every reasonable effort shall be made to maintain such voltage practically constant at all times during which service is supplied. For service rendered under a lighting contract, or primarily for lighting purposes, the variations of voltage as measured at the service terminals shall not exceed five (5%) per cent., plus or minus, of the standard service voltage for that locality, for a longer period than one minute at each instance, at any time during which service is supplied. For service rendered under a power contract, or primarily for power purposes, voltage variations as measured at the service terminals shall not exceed ten (10%) per cent., plus or minus, of the standard service voltage for that locality for a longer period than one minute at each instance: Provided, First, That this limit of ten (10%) per cent., shall not apply to power supplied from direct current trolley wires; and, Second, That a utility may, if satisfactory and approved by the Commission, furnish service under conditions of greater voltage variations, (a) upon filing with the

Commission a copy of all existing contracts containing a provision for service with such greater variation of voltage, or (b) upon filing with the Commission a copy of all existing contracts which do not contain a provision for such greater variations in voltage, together with a statement in each case of the variation in voltage existing in the service rendered under each said contract, and (c) upon filing with the Commission a copy of all contracts made hereafter which contemplate service under conditions of greater voltage variations, and which shall in each case henceforth contain a clause stating the probable variations in voltage that will occur in the service rendered under said contract: And, Provided further, that such greater variation in the voltage shall not result in unreasonable discrimination in favor of or against any consumer. Variations of voltage in excess of those specified above, caused by the operations of the consumer in violation of his contract or the rules of the utility, or from causes beyond the control of the utility, shall not be considered a violation of this rule.

III.—*Record of Station Voltage:*

Each utility shall keep in continuous operation at least one graphic recording voltmeter in each generating station. Each utility shall also place and connect additional graphic recording voltmeters at such places and for such periods of time as the Commission may from time to time require. All records from such meters shall be kept on file as specified in Rule X.

IV.—*Standard Frequency:*

Each utility supplying alternating current shall adopt a standard frequency, the suitability of which may be determined by the Commission, and shall maintain this frequency within five (5%) per cent., plus or minus, of standard, at all times during which service is supplied: Provided, That momentary variations of frequency of more than five (5%) per cent., which are clearly due to no lack of proper equipment or reasonable care on the part of the utility, shall not be considered a violation of this rule.

V.—*Records of Load and Interruptions:*

Each utility shall keep a record of the time of starting and disconnecting all street lighting circuits; of the readings of such instruments at each generating station, and at such intervals as are necessary to determine the characteristics of the load; and of all interruptions to service affecting the busbars, feeders, or distributing mains, which record shall show the time, duration, extent, and the cause when known, of the interruption. An interruption is here defined for the purpose of record only, as the interval of time during which the voltage falls below fifty (50%) per cent. of standard voltage. All such records shall be kept as specified in Rule X, for at least two years.

VI.—*Complaint Records:*

Each utility shall keep a record of all written complaints received from its consumers in regard to service, which record shall show the name and address of the complainant, the date and nature of the complaint, the action taken, and the date of final disposition of the matter. These records shall be kept as specified in Rule X

VII.—*Maintenance and Inspection:*

Each utility shall maintain its equipment and facilities and shall make periodic inspection of the same, all in accordance with good practice, and in a manner satisfactory to the Commission. Each utility shall also keep a complete record of all such inspections, as specified in Rule X, and shall file with the Commission a statement of the condition of its equipment and facilities, and such copies of its report of inspections as the Commission may require.

VIII.—*Defective Apparatus:*

Whenever any equipment or facilities, the failure of which would involve life hazard, are removed from service for any reason, they must be thoroughly inspected and tested before being again placed in service, and no equipment or facilities shall be placed in service or continued in service, which have for any reason become dangerous, or liable to cause injury to persons or damage to property.

IX.—*Accidents:*

Each utility shall keep a record of and shall furnish to the Investigator of Accidents for the Commission, in accordance with the rules of the Commission, reports of any and all accidents happening in or about or in connection with the operation of its property, facilities or service, wherein any person shall have been killed or injured, or property damaged or destroyed, with a full statement as far as possible of the causes of such accidents, and the precautions, if any, taken as prevention against future accidents of similar character.

X.—*Records and Reports:*

All records required by these Rules shall be kept within the State, at an office or offices of the utility located in the territory served by it, and shall be open for examination by the Commission or its representative. Each utility shall notify the Commission of the office or offices at which the various classes of records are kept, and shall file with the Commission such reports as the Commission may from time to time require.

Part II.

METERS.

XI.—*Allowable Error:*

No watt-hour meter shall be placed in service nor allowed to remain in service, which registers at no load when the applied voltage is less than one hundred and ten (110%) per cent. of standard service voltage, nor which is in any way mechanically defective, nor which has incorrect constants, nor an error in measurement in excess of four (4%) per cent.

XII.—*Method of Determining the Error:*

The error of a service watt-hour meter shall be determined as follows: The error at light load; here defined as not less than five (5%) per cent. nor more than ten (10%) per cent. of rated capacity for induction type meters, and not less than ten (10%) per cent. nor more than fifteen (15%) per cent. of rated capacity for

commutator type and mercury type meters—shall be determined by taking the average of at least two errors, determining from as many separate readings of the same light load, which errors must agree with each other within one-half (.5%) per cent. of registration accuracy. In the same manner the error at heavy load—here defined as not less than seventy-five (75%) per cent. nor more than one hundred (100%) per cent. of rated capacity—shall be determined.

The error of the meter shall then be determined by taking the average of the error at light load and the error at heavy load, proper account being taken of the sign of these two errors: Provided, That where the consumer's connected load does not equal seventy-five (75%) per cent. of the rated capacity of the meter, the full connected load may be considered as heavy load for purposes of test.

In all cases where it is not practicable to determine the error by the method outlined above, the utility shall have the option of installing an approved check meter or meters, and determining the error of the service meter by comparing the watt-hours registered by the check meter with the watt-hour registered by the service meter in the same time. When this option is exercised, the check meter shall be left in circuit until the hand on the first dial of the service meter shall have made at least two complete revolutions. If a utility desires to use "per cent. registration" or "accuracy," in place of "per cent. error," the percent. registration shall be determined in the same manner as provided above for determining per cent. error.

XIII.—*Meter Record:*

Each utility shall maintain a record of all its service watt-hour meters, which record shall show the name of the manufacturer, the type, the rating, the date of purchase when purchased after July 1st, 1914, the date and location of all installations in service and the removals therefrom, the date of all tests and the reasons therefor, and the error "as found" and "as left." This report shall be kept as specified in Rule X, and shall be complete and up to date within three years subsequent to July 1st, 1914.

XIV.—*Test Previous to Installation:*

Each watt-hour meter installed after July 1st, 1914, shall have been tested for accuracy by the utility within ninety (90) days previous to its installation, or shall be so tested within sixty (60) days thereafter. It shall also be inspected by the utility for proper connection, mechanical condition, and suitability of location within sixty (60) days after the installation.

XV.—*Facilities for Testing:*

Each utility shall provide for and have available, suitable and adequate facilities for testing its watt-hour meters, in each case to be satisfactory to an approval by the Commission. These facilities shall, in general, include a test bench free from unnecessary encumbrances, one or more portable rotating standard watt-hour meters, a suitable check meter or meters mounted on the test bench, and such other necessary equipment as the Commission may require. The check meter shall be the standard for the utility, and shall be periodically tested for accuracy, and adjusted when necessary by a representative of the Commission, and at such place as the Commission may direct. Immediately after making final adjustment, the tester shall seal and date tag the meter, and shall furnish the utility with a correction curve properly dated and signed.

The portable rotating standard shall also be tested and adjusted periodically by a representative of the Commission, and at such place as the Commission may direct. The tester shall furnish the utility with a correction curve properly dated and signed. During the interval between tests by the Commission, the portable standard shall be compared with the check meter at least once each week for commutating types, and at least once every two weeks for induction types, during the time the portable meter is in service, and the calibration thus obtained shall be used in determining the error of the service meters. A complete record of these check-meters shall be kept for at least two years, as specified in Rule X. This record shall show the condition and accuracy of the rotating standard "as found" and "as left;" all in such form and such detail as to permit of convenient checking of the method and results.

All correction curves furnished by the Commission shall be kept with the meter until superseded. After January 1, 1915, tests made with uncertified facilities will not be deemed authoritative.

XVI.—*Frequency of Periodic Tests:*

Each utility shall make periodic tests of all its watt-hour meters in service, in accordance with the following schedule:

- (a) Two and three wire commutating type and mercury type meters, up to and including fifty (50) amperes rated capacity of meter element, shall be tested at least once every eighteen (18) months.
- (b) Two and three wire commutating type and mercury type meters of over fifty (50) amperes rated capacity of meter element, shall be tested at least once every twelve (12) months.
- (c) Two and three wire single phase induction type meters, up to and including twenty-five (25) amperes rated capacity of meter element, and manufactured prior to January 1st, 1907, shall be tested at least once every thirty (30) months. Meters of the same type and rating manufactured since January 1st, 1907, shall be tested at least once every thirty-six (36) months.
- (d) Two and three wire single phase induction type meters of over twenty-five amperes rated capacity of meter element, shall be tested at least once every twenty-four (24) months.
- (e) Self contained polyphase meters up to and including fifty (50) k. w. rated capacity, shall be tested at least once every eighteen (18) months.
- (f) Self contained polyphase meters of over fifty (50) k. w. rated capacity, shall be tested at least once every twelve (12) months.
- (g) Polyphase meters connected through current transformers or current and potential transformers, to circuits up to and including fifty (50) k. w. rated capacity, shall be tested at least once every twenty-four (24) months.
- (h) Polyphase meters connected through current transformers, or current and potential transformers, to circuits of over fifty (50) k. w. capacity, shall be tested at least once every eighteen (18) months.

Whenever the number of meters of any type which register in error beyond the limits specified in Rule XI, is deemed by the Commission to be excessive, then this type shall be tested with such additional frequency as the Commission may direct.

XVII.—*Meters in Service Without Test Records:*

All watt-hour meters in service on and after July 1, 1914, for which there is no record of test within the time equal to the period of test for that class and rating of meter as specified in Rule XVI, shall be tested as soon thereafter as circumstances will permit. In no case shall the time subsequent to July 1, 1914, exceed the length of time of the period of test for meters of that class and rating as specified in Rule XVI.

XVIII.—*Request Tests:*

Each utility shall upon the written request of a consumer, and if he so desires, in his presence or that of his authorized representative, make a test of the accuracy of his meter. When a consumer desires, either personally or by a representative, to witness the testing of a meter, he may require the seal of the meter to be broken only in his presence or that of his representative. If the meter so tested shall be found to be accurate within the limits specified in Rule XI, a fee determined from the schedule indicated below, shall be paid to the utility by the consumer requiring such test; but if not so found, then the cost thereof shall be borne by the utility furnishing the service. When making such request, the consumer shall agree to the basis of payment herein specified. A report of such test shall be made to the consumer, and a complete record of such test shall be kept on file as specified in Rule X.

SCHEDULE OF FEES FOR TESTING WATT-HOUR METERS.

- | | |
|--|--------|
| (a) For direct current and single phase meters operating on 600 volts or less, up to and including twenty-five (25) amperes rated capacity of the meter element,..... | \$1 50 |
| (b) For each additional fifty (50) amperes or fraction thereof,..... | 50 |
| (c) For single phase meters above 600 volts, and for polyphase meters with or without instrument transformers, up to and including twenty-five k. w. rated capacity of the circuit,..... | 2 50 |
| (d) For each additional twenty-five (25) k. w. rated capacity, or fraction thereof, | 2 50 |

Rates for meters not included in the above classification, or so located that the cost is out of proportion to the fee specified, will be furnished by the Commission upon receipt of complete specifications.

XIX.—*Power Factor Adjustment:*

All alternating current watt-hour meters which are provided with a power factor compensation, should be tested and adjusted for correct registration within two (2%) per cent. plus or minus, at one hundred (100%) per cent. power factor, and within four (4%) per cent. at zero or fifty (50%) per cent. power factor (lagging) before installation. All alternating current watt-hour meters in service which have not been so tested and adjusted before installation, and which are connected to circuits supplying other than non-inductive load, shall be tested for accuracy at one hundred (100%) per cent. power factor, and at zero or fifty (50%) per cent. lagging power factor. In all cases where it is not practicable to determine the error of the meter at these power factors, the utility shall have the option of installing an approved check meter, and determining the error as provided in the last paragraph of Rule XII.

XX.—*Place of Making Tests:*

All tests provided for in Rules XIV, XVI and XVIII, and except those made previous to installation as provided for in Rule XIV, shall be made in the place of permanent location on the consumer's premises, with approved equipment and under local conditions.

XXI.—*Watt-Hour Meter Tests Without Accessories:*

In all cases where a service watt-hour meter is connected to the line through shunts, multipliers, or instrument transformers, the test may be made on the meter as a self contained unit, and the ratio of the accessories used to determine the error of the meter, provided that the certificates of the accessories bear a date within five years, and are satisfactory to the Commission.

XXII.—*Adjustment After Test:*

All service watt-hour meters shall be so adjusted after test that the error of the meter as defined in Rule XII shall not exceed two (2%) per cent. Neither shall the error at light load exceed four (4%) per cent., nor the error at heavy load exceed two (2%) per cent.

XXIII.—*Change of Frequency:*

If a utility shall change its standard of frequency, it shall give reasonable notice to all its consumers, and shall make tests and shall readjust all watt-hour meters as soon thereafter as practicable, and shall refund to the consumer all the excess charges which have been collected from him by reason of the change of frequency.

XXIV.—*Refund for Overcharge:*

If a meter be found to be fast by more than four (4%) per cent. as defined in Rule XII at any test, an allowance or refund shall be made to the consumer by the utility, equal to all the excess charged the consumer, figured back from the date of test through the entire period of the current bill, unless it can be shown that the error is due to an accident or other cause, the exact time of which is known, in which case it shall be figured back to such time.

3—COMMENTS ON THE RULES FOR REGULATING ELECTRIC UTILITIES.

The following comments were made by Prof. Harris, who prepared the Rules for Electric Utilities under the supervision of Commissioner Tone, and in cooperation with Prof. Fernald.

Rule I—*Statutory:* In a number of points, the rules are general in character and one who looks to them for specific instructions in all things will be disappointed. Many companies have well established practices, covered by these Rules, which differ for different companies, yet accomplish essentially the same results. So it

would seem unnecessary to set up an arbitrary procedure in all cases which might have "uniformity" as its sole claim for merit, however desirable uniformity might be. Taking the Rules as a whole, they should be looked upon as a sort of sign post, pointing the way to desired results, but not attempting to specify the exact manner of arriving at these results. The results themselves are necessary and desirable, and they can be accomplished with comparatively little disturbance and friction, if observed in the proper spirit.

Rule II—Voltage Variations. The purposes of this rule are two-fold, viz:

(a) To provide a reference voltage which can be used to determine the suitability of any lighting units used thereon, and on which to base any necessary calculations of voltage variations arising from subsequent complaints;

(b) To indicate the outside limits of such variations of voltage which would ordinarily be permissible.

The expression "constant voltage system" is used to distinguish the ordinary commercial circuit from the constant current circuit. It does not mean that it must be of the same voltage throughout, or that all consumers must be supplied current at the same voltage.

The clause "shall adopt standard service voltages for such systems" means simply that in the case of any question arising as to the suitability of lighting units or of the constancy of voltage supplied the consumer, the utility shall decide and state what they consider the "standard service voltage" for the place in question.

Rule III. Record of Station Voltage: The purpose of requiring a record of station voltage can be stated as follows:

(a) To stimulate the station attendants to greater attention to this feature of service;

(b) To provide a record which, while it does not necessarily show the condition at any particular point out on the line, does furnish a good indication as to whether the trouble lies within the generating station, or with the distributing system;

(c) It serves as a record of the continuity of operation of the station. A graphic recording watt-meter would accomplish this latter purpose, but could not meet the other two and, desirable as it is itself, should not be considered a substitute for the graphic recording voltmeter. In this connection I should like to point out that the total absence of graphic meters in many stations, and even of station watt-hour meters in some, would indicate a lack of exact knowledge on the part of many managers as well as a lack of appreciation of the value of such knowledge.

The practice of making voltage surveys is not as common as it should be. Such work is commonly done only on complaint, and then many times with indicating instruments. This must be unsatisfactory to the complainant and is more work for the company, and certainly less satisfactory than such inspections made with a graphic meter. Such complaints can be practically eliminated by the use of portable graphic meters, and their more frequent use is urged.

Rule V—Records of load and interruptions: These records are required primarily for the reason that they are considered essential to the intelligent operation of a station, and for the further reason that they have an important bearing on the question of the adequacy of the facilities or equipment to meet the demands made upon them.

In the absence of any graphic recording meters, it would seem advisable to take, at least, hourly readings of the feeder ammeters and watt-meters, or feeder ammeters and power factor meters, with perhaps half hour readings during the peaks.

The records of interruption should be, and usually are, kept on the station log sheet.

Rule VI—*Complaint Records.* It is recognized that practically all so-called "complaints" are not of the fault-finding variety, but merely notifications, and are usually delivered verbally or over the telephone.

All written communications from consumer to utility regarding the quality of service, whether justified or not, are complaints under this Rule and must be kept on file, together with a memorandum of the action taken in regard thereto, as called for in the Rule.

Rule VII—*Maintenance and Inspection.* Inspection is the foundation of maintenance. "Good practice" in the matter of inspections may well differ in character as well as frequency, depending upon the importance of the system itself to the community. It is reasonable to presume that the utility is more interested in maintaining uninterrupted service and preventing expensive accidents than is anyone else, and can be trusted to do what seems sufficient in this regard. Nevertheless a thorough inspection of the physical condition of the entire plant is rarely ever made, and then almost invariably by men so used to the existing condition that it is doubtful if a critical inspection is actually made. I submit for your consideration that the entire property from boiler room to distributing transformers should, in addition to the constant inspection maintained by meter readers, are lamp trimmers, line men, and others, be rigidly inspected by competent men, at least once a year, and that the condition of the property as adjudged by these inspectors should be a matter of record, such for example, as a report from the proper superintendents to the general manager, or from the general manager to the directors. Every inspector should at least report if only to say that "all is well."

Rule VIII—*Defective Apparatus.* No detail requirements can be given on this subject. Transformers in particular should be given a voltage test before installation, whether the installation be temporary or permanent.

Rule X—*Records and Reports.* This was so worded in order to eliminate the possibility of having to go outside of the Commonwealth to secure the information. It does not discourage the concentration of reports in one office, but rather encourages it. This practice of bringing all records together at one office is common in all large companies operating either in metropolitan districts or in a chain of neighboring cities and towns.

Part II.

METERS.

Rule XI—*Allowable Error.* Four per cent. is considered the outside permissible error, (96% to 104% registration). Since meters are required to be adjusted to correct registration within two per cent. (98% to 102% registration (see Rule XXII) and are customarily adjusted to correct registration within 1% after tests, this leaves a margin of from 2% to 3% or more before the utility can be penalized.

Rule XII—*Method of Determining the Error.* In several states nine separate readings are required to determine the accuracy or error of a meter; three at light load, three at half (or average) load, and three at full load; these nine readings being weighted or not before averaging, depending upon the particular rules. Only four readings are here required; two at light load and two at heavy load. This may seem to leave out of consideration that percentage of the load where, in all probability, the meter registers most of the energy passed through it, yet when it is considered that the meter must not creep on less than 10% over voltage; that it must register between 98% and 102% on light load, and that it must likewise register between 98% and 102% at heavy or full load, it does not seem that either the consumer or the utility is likely to suffer any hardship from this test at two points only. There can be no objection to testing a meter at any load between these two points, but such tests are considered unnecessary and should not be used in determining the "error of the meter."

All tests of consumer's meters should preferably be done with rotating standards. Where it is impracticable to do so, the indicating instruments should be submitted to the Commission for calibration beforehand and reserved for this purpose while such tests are being made.

Rule XIII—*Meter Records.* The practices of even the larger companies differ in this respect. Because of the established practices in vogue among many companies, involving tens of thousands of meters, which, while differing from each other, yet furnish all the necessary information, it was not considered advisable to specify uniform methods of keeping these records. For the benefit of the smaller companies which still have these records to prepare, I would suggest that the State Association could do the industry a service by considering the question of a uniform system which it could recommend to all companies not already committed to a definite program.

The simplest satisfactory form of records met with so far employs three sets of forms, viz:

(a) A meter life card which shows all the characteristics of the meter, the record of installations and removals, and the date and results of all tests; in short, showing all the information concerning a particular meter asked for in Rule XIII. These are filed numerically by serial number.

(b) A consumer's card showing the serial of the meter installed and such additional data as the utility may desire, filed alphabetically.

(c) A test slip for the use of the meter tester, showing the serial of the meter, the location, the date and results of tests. The results of the test are transferred to the "life card" and a new test slip made for the next periodic test and filed under the calendar month when such test is due.

Rule XV—*Facilities for Testing.* No attempt has been made to say here what shall be adequate for all cases. The circumstance in each case must decide. The minimum equipment which would likely suffice, would be a rotating standard and a secondary standard or check meter. The purpose of the check meter is, of course, to detect any unusual or sudden change in the accuracy of the rotating standard which might occur. For the smaller companies, where the cost of maintaining expensive secondary standards would prove a burden, suitable service type meters might be used. For this purpose only the best and most reliable service meter would be accepted.

The Commission is required to certify to the accuracy of all facilities used in testing the consumers' meters, and to this end it will designate certain standardizing laboratories in the State to which all standards may be sent for calibration. Directions will be issued later on this point.

Rule XVI—Frequency of Periodic Tests. Experience is the only guide for determining the proper period of tests. Such data as is available seems to indicate that from two to three years is a safe interval for small meters, and correspondingly shorter intervals for meters of larger capacity. The fact that meters under ordinary circumstances of wear, will tend to run slow, provides an incentive for more frequent tests on meters involving large revenue.

It is proper to suggest here that many of the smaller companies, not already equipped with meter testing facilities, might profitably employ at intervals, a competent tester with the necessary apparatus, who could make all the periodic tests required for the year in a short time. If such an arrangement was desirable, the consent of the Commission should be obtained beforehand.

Rule XIX—Power Factor Adjustments. This rule is concerned only with those meters which are connected to low power factor loads. Ordinary household loads do not come in this class. It places the responsibility for the correct registration at these low power factors squarely upon the utility furnishing the meter.

Rule XX—Place of Making Tests. The clause "under local conditions" means that the meter must not be disturbed from its mounting, nor must any external conditions, such as vibrations, stray fields, etc., be altered for the test. It does not mean that a meter must be tested on passing load, but may be tested by special loading devices if more convenient.

Rule XXI—Watt-Hour Meter Tests Without Accessories. The only phase of this rule which seems to have raised any question concerns the testing of current transformers. There are two cases to consider:

(a) Current transformers which are already in service, for which there is no ratio curve, and (b) current transformers purchased hereafter.

The two largest manufacturers will guarantee that the ratio of any particular transformers will not differ more than 1% at light load nor more than one-half per cent. at full load from the average ratio for that type and rating of transformer. The Commission will accept the manufacturer's ratio for that type and rating of transformer in lieu of a specially made curve for the individual transformer in question. This eliminates any additional expense on future purchases. As for those in service, the simplest method of test would seem to be to compare it with another similar transformer whose ratio is known. This could be done, in some cases without removing the transformers from service by connecting a new one in service with it, together with a suitable meter and comparing the registration, or if not conveniently tested in service, it could be removed to the laboratory and there compared.

The meters themselves, of course, would be tested and adjusted beforehand, so that their registration would be a correct indication of the relative ratio of the transformers.

SUMMARY OF COMMENTS.

Summing up then, there are these points regarding meters, which each utility is expected to observe:

- 1—Each meter must be tested before installation or shortly thereafter. (See Rule XIV.)
- 2—If the meter is connected to low power factor loads, the utility shall see to it that the meter is correct on low power factor. (See Rule XIX.)
- 3—Each meter is to be tested periodically. (See Rule XVI.)
- 4—These periodic tests are to be made at the consumer's premises. (See Rule XX.)
- 5—Each meter shall be adjusted after test to correct registration within two per cent. plus or minus. (See Rule XXII.)

There are three questions of policy to be noted. One of them is that the Commission does not undertake to specify in these Rules, what make or type of apparatus shall be used by the utilities, providing only that the equipment used shall meet such reasonable requirements as to accuracy and dependability as the work demands. Another is that the Commission tests only the standards of the utilities and not the consumers' meters. The third is that no periodic reports of any kind are required by these Rules. Reports will doubtless be asked for later, when the information can serve some useful purpose.

4—GAS SERVICE UTILITIES. Circular No. 9-A.

RULES AND REGULATIONS Adopted April 9, 1914.

THE PUBLIC SERVICE COMMISSION
of the
COMMONWEALTH OF PENNSYLVANIA.

Part I.

GENERAL.

Definition:

The term "utility" in these rules includes all public service companies, corporations and persons, as defined in "The Public Service Company Law," engaged in the production, sale or distribution of gas within the jurisdiction of the Commission.

I.—*Statutory:*

"It shall be the duty of every public service company to furnish and maintain such service, including facilities, as shall in all respects be just, reasonably adequate, and practically sufficient for the accommodation and safety of its patrons, employes, and the public, and in conformity with such reasonable regulations or orders as may be made by the Commission."

II.—*Pressure Variation:*

Each utility furnishing manufactured gas shall maintain at the consumer's meter outlet a gas pressure of not less than one-and-one-half inches nor more than eight inches of water pressure; and within said limits the daily variation of pressure at the outlet of any one meter on the system shall never be greater than one hundred (100%) per cent. of the minimum pressure. Each utility furnishing natural gas shall maintain at the consumer's meter outlet a gas pressure of not less than one and one-half inches, nor more than fourteen inches of water pressure, except when greater pressure is specifically provided in the contract between the utility and the consumer, provided there shall be no unfair and unreasonable discrimination or preference; and within the said limits the daily variation of pressure at the outlet of any one meter on the system shall never exceed four inches of water pressure above or below the normal pressure maintained at such point of delivery, unless it can be shown to the Commission that such greater variation is due to extraordinary demand in extreme weather.

Provided, That variations in pressure caused by operation of consumer's apparatus in violation of contract or the rules of the utility, or by causes entirely beyond the control of the utility, shall not be considered a violation of this rule.

III.—*Required Heating Value:*

Each utility furnishing manufactured gas service must supply gas which when tested within a one mile radius from the point of manufacture, shall give a monthly average of not less than 570 British thermal units total heating value per cubic foot, as referred to standard condition of temperature and pressure, except gas which in the opinion of the Commission is produced as a by-product in the manufacture of coke, which gas shall give a monthly average of not less than 550 British thermal units per cubic foot. The minimum heating value of manufactured gas shall never fall below 520 British thermal units except for by-product coke oven gas as indicated above, which shall never fall below 500 British thermal units. Manufactured gas delivered to the mains under pressure above five pounds per square inch shall be tested for heating value before compression. The minimum heating value of natural gas supplied by any utility shall never fall below 800 British thermal units per cubic foot, as referred to standard condition of temperature and pressure.

IV.—*Sulphur Requirements:*

In no case shall manufactured gas contain more than 30 grains of total sulphur per 100 cubic feet.

V.—*Service Interruptions:*

Each utility shall keep a record of all interruptions to service on the entire system or any portion thereof belonging to the utility, which record shall contain the time, extent and duration of the interruption, and shall be kept as specified in Rule IX.

VI. *Complaint Records:*

Each utility shall keep a record of all written complaints received from its consumers in regard to service, which record shall show the name and address of the complainant, the date and nature of the complaint, the action taken, and the date of final disposition of the matter. This record shall be kept as specified in Rule IX.

VII.—*Inspection of Equipment:*

Each utility shall inspect its equipment and facilities, including the necessary tests for water and leaks in its lines, in accordance with good practice, and in a manner satisfactory to the Commission, and shall maintain as specified in Rule IX, a complete record of all such inspections and tests, and shall file with the Commission a statement of the condition of its equipment and facilities, and such copies of its reports of inspections, when and in such form as the Commission may require.

VIII.—*Accidents:*

Each utility shall keep a record of and shall furnish to the Investigator of Accidents for the Commission, in accordance with the rules of the Commission, reports of any and all accidents happening in or about or in connection with the operation of its property, facilities or service, wherein any person shall have been killed or injured, or property damaged or destroyed, with a full statement as far as possible of the causes of such accidents, and the precautions, if any, taken as prevention against future accidents of similar character.

IX.—*Records and Reports:*

All records required by these rules shall be kept within the State at an office or offices of the utility located in the territory served by it, and shall be open for examination by the Commission or its representative. Each utility shall notify the Commission of the office or offices at which the various classes of records are kept and shall file with the Commission, such reports as the Commission may from time to time require.

Part II.

METERS, CALORIMETERS, ETC.

X.—*Allowable Error:*

No gas meter shall be placed in service nor allowed to remain in service, which shows in comparison with a standard gas prover, an error greater than two (2%) per cent. when gas at the standard test rate of flow is passing through it.

XI.—*Periodic Tests:*

No utility furnishing metered gas service shall allow a gas meter to remain in service for a period longer than five years without checking it for accuracy, or readjusting it if found to be incorrect beyond the limits established by Rule X. Proportional meters shall be tested once every five years and readjusted if necessary, and cleaned by a competent man at least once each three months.

XII.—*Meter Test Records:*

Whenever a gas service meter is tested, the original test record shall be kept, indicating the information necessary for identifying the meter, the reason for making the test, the reading of the meter before being disturbed, and the accuracy of the meter, together with all the data taken at the time of the test. This record must be sufficiently complete to permit the convenient checking of the methods employed, and the calculations made. A record shall also be kept, preferably numerically arranged, indicating date of meter purchase, when purchased after July 1, 1914, name of manufacturer, its size, its identification, its various places of installation, with dates of installation and removal, and the dates and general results of all tests. These records shall be kept as specified in Rule IX.

XIII.—*Installation of Meters:*

Each gas service meter installed after July 1, 1914, shall have been tested for accuracy by the utility within one year previous to its installation. It shall also be inspected by the utility for proper connections, mechanical conditions, and suitability of location within sixty (60) days after installation.

XIV.—*Facilities for Testing:*

Each utility shall provide and maintain suitable and adequate facilities for testing its gas service meters, in each case to be satisfactory to and approved by the Commission. Each utility shall provide a suitable meter prover, of not less than five (5) cubic feet capacity, equipped with suitable thermometers and other necessary accessories, and shall maintain the same in proper adjustment to register the condition of the meters within one-half of one per cent. The accuracy of all provers will be established from time to time by a representative of the Commission at a place to be designated by it. After January 1, 1915, tests made with an uncertified prover will not be deemed authoritative.

XV.—*Pressure Surveys:*

Each utility shall provide itself with one or more graphic recording pressure gauges, and shall make frequent measurements of the gas pressure variation throughout its system. Charts from these gauges showing the pressure variations shall be kept for at least two years as specified in Rule IX. The accuracy of all pressure gauges will be established from time to time by a representative of the Commission at a place to be designated by it. After January 1, 1915, tests made with an uncertified pressure gauge will not be deemed authoritative.

XVI.—*Calorimeter Tests:*

Each utility whose gas output exceeds twenty million cubic feet per year shall equip itself with a complete standard calorimeter outfit approved by the Commission, by which it shall determine the heat value of manufactured gas at least three days each week, and of natural gas at least three times per year. A complete record of all these tests shall be kept as specified in Rule IX. The accuracy of all calorimeters will be established from time to time by a representative of the Commission at a place to be designated by it. After January 1, 1915, tests made with an uncertified calorimeter will not be deemed authoritative.

XVII.—*Meters in Service without Test Records:*

All gas meters in service after July 1, 1914, for which there is no record test within five years, must be tested as soon thereafter as circumstances will permit, and in all cases within three years from July 1, 1914.

XVIII.—*Request Tests:*

Each utility shall upon the written request of a consumer, and if he so desires, in his presence or that of his authorized representative, make a test of the accuracy of his meter. When a consumer desires, either personally or through a representative, to witness the testing of a meter, he may require the meter to be sealed in his presence before removed, which seal shall not be broken until the test is made in his presence. If the meter so tested shall be found to be accurate within the limits specified in Rule X, a fee determined from the schedule indicated below, shall be paid to the utility by the consumer requiring such test; but if not so found, then the cost thereof shall be borne by the utility furnishing the service. When making such request, the consumer shall agree to the basis of payment herein specified. A report of such test shall be made to the consumer, and a complete record of such test shall be kept on file as specified in Rule IX.

The amount of the fee to be charged by the utility for testing meters upon written complaint of consumers, shall be determined by the manufacturers' designated rating, as follows:

Meters of 10-Lt. capacity or under, or having a rated capacity of 200 cubic feet per hour or under,	\$2 00
Meters of over 10-Lt. capacity and not exceeding 30-Lt. capacity, or having a rated capacity exceeding 200 cubic feet per hour, and not exceeding 600 cubic feet per hour,	4 00
Meters of over 30-Lt. capacity and not exceeding 80-Lt. capacity, or having a rated capacity exceeding 600 cubic feet per hour, and not exceeding 1,500 cubic feet per hour,	6 00
Meters of over 80-Lt. capacity, or having a rated capacity exceeding 1,500 cubic feet per hour,	10 00

PROPORTIONAL METERS.

All Proportional Meters not exceeding 15,000 cubic feet per hour rated capacity,	15 00
All Proportional Meters of over 15,000 cubic feet and not exceeding 30,000 cubic feet per hour,	20 00
All Proportional Meters of over 30,000 cubic feet and not exceeding 50,000 cubic feet per hour rated capacity,	30 00
All Proportional Meters of over 50,000 cubic feet and not exceeding 100,000 cubic feet per hour rated capacity,	40 00
All Proportional Meters of over 100,000 cubic feet per hour rated capacity, ..	50 00

Rates for testing meters not included in the above classification, or which are so located that the cost is out of proportion to the fee specified, will be furnished by the Commission upon receipt of complete specifications.

XIX.—*Refunds:*

If a meter be found to be fast at any test by more than two (2%) per cent., an allowance or refund shall be made to the consumer by the utility, equal to all the excess charged the consumer, figured back from the date of test through the entire period of the current bill, unless it can be shown that the error is due to an accident or other cause the exact date of which can be determined, in which case it shall be figured back to such time.

5—COMMENTS ON THE RULES FOR REGULATING GAS UTILITIES.

The following comments were made by Prof. Fernald, who prepared the Rules for Gas Utilities, under the supervision of Commissioner Tone, and in co-operation with Prof. Harris:

Required Heating Valve:

For a great many years, the quality of gas was largely determined by means of the so-called candle power requirement, and many ordinances and regulations still cling to the candle power test. When open flame gas burners were in general use, the candle power standard was undoubtedly the most effective and altogether the most satisfactory one. Today, however, when probably not over ten per cent. of the total gas used is consumed in open burners it is questionable whether the candle power standard is of any real service in determining gas quality. For use in connection with gas ranges for cooking, incandescent mantles for lighting, furnaces, ovens and pits for heating, and gas engines for power development, a quality requirement based on the heating value of the gas seems to be more consistent to day than a candle power requirement, and the double standard recommended by some seems quite unnecessary. Experts in the field of gas manufacture seem to be almost unanimous in the feeling that proper regulation of heating value can be more readily obtained than of candle power. They are, therefore, distinctly of the opinion that in general the one standard, heating value, is the desirable one. It is undoubtedly true that in certain sections of the older cities of Pennsylvania open flame burners are more or less in use, and it is possible that in a few of these cities these burners may utilize as much as 25 per cent. of the gas supplied to these communities, but these burners are rapidly being displaced by the mantle type, and when natural gas is taken into consideration, it is probable that the total gas utilized in open flame burners will fall well below the 10 per cent. limit indicated above. The need, therefore, of the candle power standard seems to be obsolete. Assuming that, for state regulation, the single standard of heating value is to be adopted, it becomes necessary to determine the definite heating values which shall serve as limits in the regulations imposed. At least two heating value standards must be recognized, one for manufactured gas and one for natural gas.

Several kinds of manufactured gas have to be considered. At present these are coal gas, carbureted water gas, coke oven gas, mixed gas and oil gas. Coal gas is made by the destructive distillation of coal in retorts which are externally heated. Approximately 5 cubic feet of gas are secured per pound of coal, and the heat value of such gas usually ranges from 550 to 630 B. t. u. per cubic foot. Carbureted water gas is the result of a combination of two gas-making processes. Water gas is generated by turning a jet of steam upon an incandescent fuel bed. This water gas is usually enriched by the addition of gas generated from oil, the resultant gas being known as carbureted water gas. The larger portion of the illuminating gas in this country is of this type. Carbureted water gas usually has a heating value ranging from 500 to 650 B. t. u. per cubic foot. Coke oven gas is practically a regular coal gas but the process of manufacture is somewhat different from that of the so-called coal gas. The primary object of the coke plant is the manufacture of coke, and the gas generated is practically a by-product. The heating value of coke oven gas is usually somewhat lower than that of ordinary coal gas. Mixed gas—many plants today are manufacturing a so-called mixed gas which is nothing more or less than a mechanical mixture of carbureted water gas and coal or coke oven gas. Oil gas:—In the oil districts of the country large quantities of gas are made directly from crude oil.

In determining the proper standard for the heating value of gas in any community it is essential that the types of gas manufactured in that territory be carefully considered, and that the efficiency of the processes of manufacture or the individual standards of the companies furnishing this commodity be taken into account when first establishing a basis for regulation. This is essential because it is important that sufficient leeway be granted to meet the commercial conditions involved in the manufacture of the different types of gas of reasonable quality supplied in the different sections of a State. It should further be recognized that to impose too rigorous conditions during the early application of new laws may mean either excessive expense to the smaller companies, resulting in an abnormal increase in the cost of gas to the public, or the impossibility on the part of the utility to carry out the requirements imposed. An examination of the heating value standards of various states and cities shows the average to be about 600 B. t. u. per cubic foot; but in the majority of these cases the gas is limited to three varieties, namely, coal gas, carbureted water gas or mixed gas. It is usually customary in all such regulations to permit a maximum variation of 50 heat units below the average monthly requirements, that is, the usual stipulation is that the utility furnishing manufactured gas service must supply gas of not less than 600 B. t. u. total heating value per cubic foot as referred to standard conditions of temperature and pressure, and that the minimum heating value shall never fall below 550 B. t. u.

It is undoubtedly true that many companies are to day manufacturing gas of a considerably lower heat value than they imagine. Owing to the fact that they have not been working under strict regulations they have never actually made any heat value determinations, but assume that the gas which they manufacture is necessarily equal in heat value to that of certain other plants from which they have obtained information. A recent report of a joint committee on calorimetry of the public service commission and gas corporations of a state that has been living under gas regulation for several years, indicates that even without considering coke oven gas, the 600 heat unit standard seems high, and this committee has seen fit to recommend an average standard of 570 B. t. u. If coke oven gas becomes an important factor, it seems consistent to make the standard even lower than that recommended by this committee.

As a summary of the various recommendations and regulations now in force, the following requirements seem consistent for the best results to day:

For states already working under gas regulations and in which the manufactured gas supply consists entirely of coal gas, carbureted water gas and mixed gas, a standard of 570 B. t. u. per cubic foot for the monthly average seems to be very satisfactory, although for states in which gas regulation is just being introduced or in which coke oven gas plays an important part, this heat value standard may in some instances be wisely reduced slightly below these figures, with a minimum in each case, as previously outlined, of 50 heat units below the monthly average.

The heat value of natural gas ranges from about 700 to over 1,100 B. t. u. per cubic foot. It seems to be consistent to require a quality of natural gas that shall insure a heat value of not less than 800 heat units as a minimum. These heat value determinations of the gas are made on the basis of recognized standard conditions of temperature and pressure.

Bearing the above points in mind, the following rules for *required heating value* as adopted by the Public Service Commission of the Commonwealth of Pennsylvania, seem to be entirely consistent:

Each utility furnishing manufactured gas service must supply gas, which, when tested within a one mile radius from the point of manufacture, shall give a monthly average of not less than 570 British thermal units total heating value per cubic foot, as referred to standard conditions of temperature and pressure, except gas, which, in the opinion of the Commission, is produced as a by-product in the manufacture of coke, which gas shall give a monthly average of not less than 550 British thermal units per cubic foot. The minimum heating value of manufactured gas shall never fall below 520 British thermal units except for by-product coke oven gas as indicated above, which shall never fall below 500 British thermal units. Manufactured gas delivered to the mains under pressures above 5 pounds per square inch, shall be tested for heating value before compression. The minimum heating value of natural gas supplied by any utility shall never fall below 800 British thermal units per cubic foot, as referred to standard conditions of temperature and pressure.

Gas manufacturers who have been accustomed to no special standards can undoubtedly improve the uniformity of the quality of the gas supplied by their plants, and it may prove consistent for the State Commission to increase these requirements from time to time.

Sulphur Requirements:

The phrase "quality of gas" not only relates to its heating value, but also to freedom from impurities. Manufacturers of gas are expected satisfactorily to control, among other impurities, the proportions of hydrogen sulphide, total sulphur and ammonia. Gas engineers seem to differ radically as to the seriousness of a trace of hydrogen sulphide in gas. Some claim that a trace does absolutely no harm save that the odor produced when the gas is burned is objectionable. Others claim that this odor serves a useful purpose in warning of leaks or open valves. The removal of hydrogen sulphide is a comparatively simple process, and the gas company that has any interest in the attitude of its customers will see that its gas is free from this somewhat offensive impurity. It seems, therefore, hardly necessary

to include any requirements regarding hydrogen sulphide, but gas regulations should specify the total amount of sulphur that will be permitted, inasmuch as it is quite possible in good practice with the grades of coal used to day to reduce the amount of sulphur to 20 grains or less per 100 cubic feet of gas produced. It has become customary to make the maximum limit as prescribed in the regulations of the Pennsylvania Commission, 30 grains of total sulphur per 100 cubic feet. This serves as a regulator, and at the same time cannot be regarded as a hardship.

Pressure Variation:

The regulation of the pressure at which gas is supplied to the customer's appliances seems to be imperative if service is to be of a thoroughly satisfactory nature. This is emphasized distinctly in the following passage from the 1909 report of the Wisconsin Railroad Commission:

"It has been shown that in general the gas furnished in cities of this state has been of good quality and the value has been uniform. In spite of this fact, complaint is frequently heard of 'poor gas.' The summary of gas complaints and our own experience have shown "poor gas," as the consumer uses the term, to be synonymous with "poor pressure" and may be due to one or more of a number of causes. It may be that the pressure furnished to the mains is inadequate, that the service or house piping is inadequate or otherwise faulty, or that the pressure is unsuited to the adjustment of the appliances in which gas is used. In most cases, however, it goes back to the matter of pressure. For this reason, the control of the gas pressure is the most important single factor in securing satisfactory service. The use of gas has been greatly extended in the last few years, and all of the appliances which have come into use require a higher pressure than the old open flame burner. It is stated in the discussion of pressure in a former bulletin that the pressure under $1\frac{1}{2}$ inches is unsatisfactory. Most of the companies in the state maintain a standard pressure of about $2\frac{1}{2}$ inches, and it has been noticed in general, where the pressure drops below two inches, complaints are heard."

Owing to this tendency to increase gas pressures, the majority of gas appliances are to-day regulated for pressures of from 2 to 6 inches of water pressure when operating on manufactured gas, and for a somewhat higher range of pressures when operating on natural gas. Experience seems to show that the most satisfactory results are secured with incandescent mantles, gas ranges and other household appliances when the pressure is greater than 2 inches. When gas appliances have been adjusted for certain definite pressures it is exceedingly difficult to get satisfactory results if the pressure is allowed to fluctuate through wide ranges or at frequent intervals. It becomes incumbent upon the gas companies, therefore, to hold pressures within certain ranges and to control the daily variation within reasonable limits.

The following pressure requirements adopted by the Pennsylvania Commission seemed to protect the public on the one hand, and to be entirely fair to the utility on the other:

Each utility furnishing manufactured gas shall maintain at the consumer's meter outlet a gas pressure of not less than one and one-half inches nor more than eight inches of water pressure; and within said limits the daily variation of pressure at the outlet of any one meter on the system shall never be greater than one hundred (100%) per cent. of the minimum pressure. Each utility furnishing natural gas shall maintain at the consumer's meter outlet a gas pressure not less than one and one-half inches, nor more than fourteen inches of water pressure, except when greater pressure is specifically provided in the contract between the utility and the consumer, provided there shall be no unfair and unreasonable dis-

crimination or preference; and within the said limits the daily variation of pressure at the outlet of any one meter on the system shall never exceed four inches of water pressure above or below the normal pressure maintained at such point of delivery, unless it can be shown to the Commission that such greater variation is due to extraordinary demand in extreme weather. Provided, That variations in pressure caused by operation of consumer's apparatus in violation of contract or the rules of the utility, or by causes entirely beyond the control of the utility, shall not be considered a violation of the rule.

Measurement of Commodity Supplied:

In order that the consumer may be assured of the correctness of bills submitted for service rendered, it becomes imperative that some definite standard of reliability be adopted for meters used in measuring gas, heat or water. In general, it has been found that the accuracy of properly constructed meters may easily be maintained within a very small percentage when used under suitable conditions. An examination of the degree of accuracy, common in commercial use, will establish the consistency of the following rules relating to the allowable error:

"No gas meter shall be placed in service nor allowed to remain in service, which shows in comparison with a standard gas prover, an error greater than two (2%) per cent. when gas at the standard test rate of flow is passing through it."

It also becomes important in the interest of good service that the accuracy of such meters shall be definitely checked periodically. Each utility should, then, be required to check the accuracy of all meters within stated periods, and to re-adjust them if found to be incorrect. The propriety of the following rules is, therefore, apparent:

"No utility furnishing metered gas shall allow a gas meter to remain in service for a period longer than five years without checking it for accuracy, or readjusting it if found to be incorrect beyond the limits established by Rule X. Proportional meters shall be tested once every five years and readjusted if necessary, and cleaned by a competent man at least once each three months."

From time to time, consumers feel that their meters are inaccurate, and that their bills are excessive. Although meters may register in favor of the utility, yet, as a rule, when they are in error, their registration is favorable to the consumer. The impression regarding the inaccuracy of the meter is sometimes due to natural but overlooked causes, such as extreme weather conditions, social functions or other temporary but excessive demands. It is customary, therefore, to make provision for the checking of any meter at the request of any consumer under certain specific conditions. Among other conditions imposed, it seems consistent to require the consumer to pay a reasonable fee for such special test if the meter so tested shall be found to be accurate within the limits specified by the regulations, but if the meter is not so found, then the cost of the test should not fall upon the consumer. Similarly, if the meter be found to be fast by more than a fixed percentage, an allowance or refund should be made to the consumer by the utility.

In connection with the checking of meters, it becomes incumbent upon the utility to provide and maintain suitable and adequate facilities for testing meters, gauges, calorimeters and other required accessories. The facilities for testing must of necessity be satisfactory to and approved by the Commission.

Continuity of Service:

Satisfactory service from a utility implies continuity of service at all times during the prescribed periods for which such service is supposedly rendered, together with the reasonable protection from injury to persons or property resulting from defective equipment or carelessness. With these points in view, the service regulations require of the utilities inspection of their equipment and facilities in a manner satisfactory to the Commission.

As a means of protection to both the utility and the consumer, and in order to supply the Commission with the essential facts in case of controversy, it becomes incumbent upon the utility to keep reliable records and reports of the conditions found upon inspection, of all written complaints received from its customers in regard to service, of interruptions to service and of any and all accidents related in any way to the companies' equipment or facilities.

6—HEATING SERVICE UTILITIES.

Circular No. 11-A.

RULES AND REGULATIONS

Adopted April 9, 1914.

THE PUBLIC SERVICE COMMISSION
of the
COMMONWEALTH OF PENNSYLVANIA.

Part I.

GENERAL.

Definition:

The term "utility" as used in these rules includes all public service companies, corporations and persons, as defined in The Public Service Company Law, engaged in the production, sale or distribution of heat within the jurisdiction of the Commission.

I.—Statutory:

"It shall be the duty of every public service company to furnish and maintain such service, including facilities, as shall in all respects be just, reasonably adequate, and practically sufficient for the accommodation and safety of its patrons, employees, and the public, and in conformity with such reasonable regulations or orders as may be made by the Commission."

II.—Service Interruptions:

Each utility shall keep a record of all interruptions to service on the entire system or any portion thereof, belonging to the utility, which record shall contain the time, cause, extent and duration of the interruption, and shall be kept as specified in Rule VI.

III.—*Complaint Record:*

Each utility shall keep a record of all written complaints received from its consumers in regard to service, which record shall show the name and address of the complainant, the date and nature of the complaint, the action taken, and the date of final disposition of the matter. This record shall be kept as specified in Rule VI.

IV.—*Inspection of Equipment:*

Each utility shall inspect its equipment and facilities, in accordance with good practice, and in a manner satisfactory to the Commission, and shall maintain a complete record of all such inspections and tests as specified in Rule VI.

V.—*Accidents:*

Each utility shall keep a record of and shall furnish to the Investigator of Accidents for the Commission, in accordance with the rules of the Commission, reports of any and all accidents happening in or about or in connection with the operation of its property, facilities or service, wherein any person shall have been killed or injured, or property damaged or destroyed, with a full statement as far as possible of the causes of such accidents, and the precautions, if any, taken as prevention against future accidents of similar character.

VI.—*Records and Reports:*

All records required by these rules shall be kept within the State at an office or offices of the utility located in the territory served by it, and shall be open for examination by the Commission or its representative. Each utility shall notify the Commission of the office or offices at which the various classes of records are kept, and shall file with the Commission such reports as the Commission may from time to time require.

Part II.

METERS

VII.—*Allowable Error:*

No condensation meter or hot water meter shall be placed in service nor allowed to remain in service, which has an error in registration of more than four (4%) per cent. when the water at its average temperature and standard test rate of flow is passing through the meter.

VIII.—*Periodic Tests:*

No utility furnishing metered heating service shall allow a condensation meter to remain in service for a period longer than two years, or hot water meter to remain in service for a period longer than four years, without checking it for accuracy and readjusting it if found to be incorrect beyond the limits established by Rule VII.

IX.—*Meter Test Records:*

Whenever a heating service meter is tested, the original test record shall be kept as specified in Rule VI. This record shall indicate the information necessary for identifying the meter, the reason for making the test, the reading of the meter before being disturbed, and the accuracy of the meter, together with all data taken at the time of the test. This record must be sufficiently complete to permit the convenient checking of the methods employed and the calculations made. A record shall also be kept, preferably numerically arranged, indicating date of meter purchase, when purchased after July 1, 1914, name of manufacturer, its size, identification, its various places of installation with dates of installation and removal, and the dates and general results of all tests.

X.—*Installation of Meters:*

Each heating service meter installed after July 1, 1914, shall have been tested for accuracy by the utility within one year previous to its installation. It shall also be inspected by the utility for proper connections, mechanical conditions, and suitability of location within sixty (60) days after installation.

XI.—*Facilities for Testing:*

Each utility shall provide and maintain suitable and adequate facilities for testing its heating service meters, in each case to be satisfactory to and approved by the Commission. Each utility shall own a complete meter testing equipment of a form approved by the Commission. The accuracy of this testing equipment shall be established from time to time by a representative of the Commission at a place to be designated by it. After January 1, 1915, tests made with uncertified equipment will not be deemed authoritative.

XII.—*Meters In Service Without Test Records:*

All condensation meters in service on and after July 1, 1914, for which there is no record of test within two years, must be tested as soon thereafter as circumstances will permit, and in all cases within twelve months from July 1, 1914. All hot water meters in service on and after July 1, 1914, for which there is no record of test within four years, shall be tested as soon thereafter as circumstances will permit, and in all cases within twelve months from July 1, 1914.

XIII.—*Request Tests:*

Each utility shall, upon the written request of a consumer, and if he so desires, in his presence or that of his authorized representative, make a test of the accuracy of his meter. When a consumer desires, either personally or through a representative, to witness the testing of a meter, he may require the meter to be sealed in his presence before removal, which seal shall not be broken until the test is made in his presence. If the meter so tested shall be found to be accurate within the limits specified in Rule VII, a fee determined from the schedule indicated below shall be paid to the utility by the consumer requiring such test; but if not so found, then the cost thereof shall be borne by the utility furnishing the service. When making such request, the consumer shall agree to the basis of payment herein specified. A report of such test shall be made to the consumer, and a complete record of such test shall be kept as specified in Rule VI. The amount of the fee

shall be two dollars for each heating service meter having an outlet not exceeding one inch for hot water meters and an inlet not exceeding one inch for condensation meters; for other hot water meters having an outlet not exceeding two inches, the test fee shall be five dollars per meter. Rates for meters not included in the above classification, or which are so located that the cost is out of proportion to the fee specified, will be furnished by the Commission upon receipt of complete specifications.

XIV.—*Refunds:*

If a meter be found to be fast at any test by more than four (4%) per cent. an allowance or refund shall be made to the consumer by the utility, equal to all the excess charged the consumer, figured back from the date of test through the entire period of the current bill, unless it can be shown that the error is due to an accident or other cause, the exact date of which can be determined, in which case it shall be figured back to such time.

7—WATER SERVICE UTILITIES. Circular No. 12-A.

RULES AND REGULATIONS Adopted April 9, 1914.

THE PUBLIC SERVICE COMMISSION of the COMMONWEALTH OF PENNSYLVANIA.

Part I.

GENERAL.

Definition:

The term "utility" as used in these rules includes all public service companies, corporations and persons, as defined in The Public Service Company Law, engaged in the sale or distribution of water within the jurisdiction of the Commission.

I.—*Statutory.*

"It shall be the duty of every public service company to furnish and maintain such service, including facilities, as shall in all respects be just, reasonably adequate and practically sufficient for the accommodation and safety of its patrons, employees, and the public, and in conformity with such reasonable regulations or orders as may be made by the Commission."

II.—*Service Interruptions:*

Each utility shall keep a record of all interruptions to service on the entire system or any portion thereof, belonging to the utility, which record shall contain the time, cause, extent and duration of the interruption, and shall be kept as specified in Rule VI.

III.—*Complaint Records:*

Each utility shall keep a record of all written complaints received from its consumers in regard to service, which record shall show the name and address of the complainant, the date and nature of the complaint, the action taken and the date of final disposition of the matter. These records shall be kept as specified in Rule VI.

IV.—*Inspection of Equipment:*

Each utility shall inspect its equipment and facilities, in accordance with good practice, and in a manner satisfactory to the Commission, and shall keep a complete record of all such inspections and tests as specified in Rule VI.

V.—*Accidents:*

Each utility shall keep a record of and shall furnish to the Investigator of Accidents for the Commission, in accordance with the rules of the Commission, reports of any and all accidents happening in or about or in connection with the operation of its property, facilities or service, wherein any person shall have been killed or injured, or property damaged or destroyed, with a full statement as far as possible of the causes of such accidents, and the precautions, if any, taken as prevention against future accidents of similar character.

VI.—*Records and Reports:*

All records required by these Rules shall be kept within the State, at an office or offices of the utility located in the territory served by it, and shall be open for examination by the Commission or its representative. Each utility shall notify the Commission of the office or offices at which the various classes of records are kept, and shall file with the Commission such reports as the Commission may from time to time require.

Part II.

METERS.

VII.—*Allowable Error:*

No water meter shall be placed in service nor allowed to remain in service, which has an error in registration of more than four (4%) per cent. when water is passing through it at approximately the following rates of flow:

- $\frac{5}{8}$ inch meter, 6 gallons per minute;
- $\frac{3}{4}$ inch meter, 10 gallons per minute;
- 1 inch meter, 20 gallons per minute;
- 1½ inch meter, 30 gallons per minute;

- 2 inch meter, 50 gallons per minute;
- 3 inch meter, 90 gallons per minute;
- 4 inch meter, 180 gallons per minute;
- 6 inch meter, 300 gallons per minute;

VIII.—*Periodic Tests:*

No utility furnishing metered water service shall allow a water meter to remain in service for a period longer than or for a registration greater than that specified in the following table, without checking it for accuracy, and readjusting it if found to be incorrect beyond the limits established in Rule VII.

- $\frac{5}{8}$ inch meter, 10 years or 100,000 cubic feet;
- $\frac{3}{4}$ inch meter, 8 years or 150,000 cubic feet;
- 1 inch meter, 6 years or 300,000 cubic feet;
- All meters above 1 inch, 4 years.

IX.—*Meter Test Records:*

Whenever a water service meter is tested, the original test record shall be kept as specified in Rule VI, indicating the information necessary for identifying the meter, the reason for making the test, the reading of the meter before being disturbed, and the accuracy of the meter, together with all data taken at the time of the test. This record must be sufficiently complete to permit the convenient checking of the methods employed and the calculations made. A record shall also be kept, preferably numerically arranged, indicating date of meter purchase, when purchased after July 1, 1914, name of manufacturer, its size, its identification, its various places of installation with dates of installation and removal, and the dates and general results of all tests.

X.—*Installation of Meters:*

Each water service meter installed after July 1, 1914, shall have been tested for accuracy by the utility within one year previous to its installation. It shall also be inspected by the utility for proper connections, mechanical condition, and suitability of location within sixty (60) days after installation.

XI.—*Facilities for Testing:*

Each utility shall provide and maintain suitable and adequate facilities for testing its water service meters, in each case to be satisfactory to and approved by the Commission. Each utility shall own a complete testing equipment of a form approved by the Commission. The accuracy of the testing equipment will be established from time to time by a representative of the Commission at a place to be designated by it. After January 1, 1915, tests made with uncertified equipment will not be deemed authoritative.

XII.—*Meters in Service Without Test Records:*

All water meters in service on or after July 1st, 1914, for which there is no record of test within five years, must be tested as soon thereafter as circumstances will permit, and in all cases within two years from July 1, 1914.

XIII.—*Request Tests.*

Each utility shall upon the written request of a consumer and if he so desires, in his presence or that of his authorized representative, make a test of the accuracy of his meter. When a consumer desires, either personally or through a representative, to witness the testing of a meter, he may require the meter to be sealed in his presence before removal, which seal shall not be broken until the test is made in his presence. If the meter so tested shall be found to be accurate within the limits herein specified, a fee determined from the schedule indicated below, shall be paid to the utility by the consumer requiring such test; but if not so found, then the cost thereof shall be borne by the utility furnishing the service. When making such request the consumer shall agree to the basis of payment herein specified. A report of such test shall be made to the consumer, and a complete record of such test shall be kept as specified in Rule VI. The amount of fee shall be two dollars for each water service meter having an outlet not exceeding one inch; for other water service meters having an outlet not exceeding two inches, the test fee shall be five dollars per meter.

Rates for testing meters not included in the above classification, or which are so located that the cost is out of proportion to the fee specified, will be furnished by the Commission upon receipt of complete specifications.

XIV.—*Refunds:*

If a meter be found to be fast at any test by more than four (4%) per cent., an allowance or refund shall be made to the consumer by the utility, equal to all the excess charged the consumer, figured back from the date of test through the entire period of the current bill, unless it can be shown that the error is due to an accident or other cause, the exact date of which can be determined, in which case it shall be figured back to such time.

8—COMMENTS ON THE RULES FOR REGULATING HEATING AND WATER SERVICE UTILITIES.

The following comments were made by Prof. Fernald, who prepared the Rules for Heating and Water Utilities under the supervision of Commissioner Tone and in co-operation with Prof. Harris:

Heat and Water Service:

Owing to the nature of the commodities furnished by the utilities engaged in the sale or distribution of heat or water, no detailed requirements regarding the quality of the commodity need be specified beyond the general requirements of the statutory clause upon which the rules of the Commission are based. This clause reads:

"It shall be the duty of every public service company to furnish and maintain such service, including facilities, as shall in all respects be just, reasonably adequate, and practically sufficient for the accommodation and safety of its patrons, employees, and the public, and in conformity with such reasonable regulations or orders as may be made by the Commission."

Measurement of Commodities Supplied:

In order that the consumers may be assured of the correctness of bills submitted for service rendered, it becomes imperative that some definite standard of reliability be adopted for meters used in measuring gas, heat or water. In general, it has been found that the accuracy of properly constructed meters may easily be maintained within a very small percentage when used under suitable conditions. An examination of the degree of accuracy, common in commercial use, will establish the consistency of the following rules relating to the allowable error:

(a) No condensation meter or hot water meter shall be placed in service nor allowed to remain in service which has an error in registration of more than four (4%) per cent. when the water at its average temperature and standard test rate of flow is passing through the meter.

(b) No water meter shall be placed in service nor allowed to remain in service, which has an error in registration of more than four (4%) per cent. when water is passing through it at approximately the following rates of flow:

$\frac{1}{8}$ inch meter,	6 gallons per minute;
$\frac{1}{4}$ inch meter,	10 gallons per minute;
1 inch meter,	20 gallons per minute;
$1\frac{1}{2}$ inch meter,	30 gallons per minute;
2 inch meter,	50 gallons per minute;
3 inch meter,	90 gallons per minute;
4 inch meter,	180 gallons per minute;
6 inch meter,	300 gallons per minute;

The rates of flow established for the water meters represent approximately one-third of the catalogue rate prescribed for such meters, as this one-third basis seems to represent approximately average service conditions.

It also becomes important in the interest of good service that the accuracy of such meters shall be definitely checked periodically. Each utility should, then, be required to check the accuracy of all meters within stated periods and to readjust them if found to be incorrect. The propriety of the following rules is, therefore, apparent:

(a) No utility furnishing metered heating service shall allow a condensation meter to remain in service for a period longer than two years, or hot water meter to remain in service for a period longer than four years, without checking it for accuracy and readjusting it if found to be incorrect beyond the limits established by Rule VII.

(b) No utility furnishing metered water service shall allow a water meter to remain in service for a period longer than, or for a registration greater than, that specified in the following table, without checking it for accuracy, and readjusting it if found to be incorrect beyond the limits established in Rule VII.

$\frac{1}{8}$ inch meter,	10 years or 100,000 cubic feet;
$\frac{1}{4}$ inch meter,	8 years or 150,000 cubic feet;
1 inch meter,	6 years or 300,000 cubic feet;
All meters above 1 inch, 4 years.	

From time to time, consumers feel that their meters are inaccurate and that their bills are excessive. Although meters may register in favor of the utility, yet as a rule, when they are in error, their registration is favorable to the consumer. The impression regarding the inaccuracy of the meter is sometimes due to natural but overlooked causes, such as, extreme weather conditions, social functions or other temporary but excessive demands. It is customary, therefore, to make provision for the checking of any meter at the request of any consumer under certain specific conditions. Among other conditions imposed, it seems consistent to require the consumer to pay a reasonable fee for such special test if the meter so tested shall be found to be accurate within the limits specified by the regulations, but if

the meter is not so found, then the cost of the test should not fall upon the consumer. Similarly, if the meter be found to be fast by more than a fixed percentage, an allowance or refund should be made to the consumer by the utility.

In connection with the checking of meters, it becomes incumbent upon the utility to provide and maintain suitable and adequate facilities for testing meters, gauges, and other required accessories. The facilities for testing must of necessity be satisfactory to and approved by the Commission.

Continuity of Service:

Satisfactory service from a utility implies continuity of service at all times during the prescribed periods for which such service is supposedly rendered, together with the reasonable protection from injury to persons or property resulting from defective equipment or carelessness. With these points in view, the service regulations require of the utilities inspection of their equipment and facilities in a manner satisfactory to the Commission.

As a means of protection to both the utility and the consumer, and in order to supply the Commission with the essential facts in case of controversy, it becomes incumbent upon the utility to keep reliable records and reports of the conditions found upon inspection, of all written complaints received from its customers in regard to service, of interruptions to service and of any and all accidents related in any way to the companies' equipment or facilities.

9—SUMMARY OF REGULATION OF THE FOUR UTILITIES:

Modern business methods accompanied by improved systems of manufacture and distribution, have tended toward a reduction in the prices of several commodities furnished by public utilities, but in many cases this reduction has been largely offset by the increased cost of materials, fuel and labor. Higher standards of service are demanded by the public, but any attempt on the part of the utility to increase prices is met with stubborn resistance. Disinterested, impartial and fair regulation is needed in such cases. The Public Service Commission is established for adjusting such matters, and the public should recognize the propriety of an increase in the price of a commodity just as much as a decrease, when the character of the service rendered warrants it or requires it in order to guarantee a reasonable financial return.

It is recognized that it is to day the policy of many utilities to maintain standards of service that are superior to any demands made by the regulations adopted by The Public Service Commission of Pennsylvania. There are, however, companies in every community that have never known any standard, and a definite basis for their future procedure is required. It is believed that a just and reasonable application of the regulations adopted will result in high standards of service, uniformly fair prices, reasonable financial returns and a more cordial relation between the public and the utilities.

PART FOUR

IMPROVEMENT OF THE PORT OF PHILADELPHIA

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- I. INTRODUCTION.
 - II. PRESENT CONDITIONS AND PROSPECTS OF THE PORT.
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PART FOUR

IMPROVEMENT OF THE PORT OF PHILADELPHIA

I. INTRODUCTION.

STATE LAWS AND STATE APPROPRIATIONS.

The State of Pennsylvania has assumed joint responsibility with the City of Philadelphia for the regulation and improvement of the Port of Philadelphia.

1—*The Port Warden Law of 1803.*

In 1803, the General Assembly established a Board of Wardens for the Port of Philadelphia. This Board consisted of one Master Warden and six assistant wardens, four of whom were inhabitants of the city of Philadelphia, one of the Northern Liberties and one of the district of Southwark, to be yearly appointed by the Governor of the Commonwealth.

The Master Warden was required to attend daily at the office. The Board was required to meet at least once a month for the transaction of business. The Board was given full power and authority to grant licenses to persons to act as pilots in the Bay and River Delaware, and to make rules for the government of pilots; to decide all differences which might arise between masters, owners and consignees of ships or vessels and pilots; to direct the mooring of ships and vessels in the harbor and the order in which they shall lay, load or unload at the wharves and to make, ordain and publish such rules and regulations and with such penalties for the breach thereof, as they shall seem fitting and proper: *Provided*, That this shall not be contrary to the Constitution and Laws of the United States or of the Commonwealth.

The Master Warden and clerk was compensated by salary. The law provided that if the moneys paid into the hands of the Master Warden were insufficient to pay the expenses incurred in conducting the business, the Governor may draw a warrant upon the State Treasurer for the amount of such deficiency.

No person was permitted to erect a wharf or building beyond low water mark of the River Delaware without a license.

A penalty was established for obstructing a passage over wharves, but this regulation was not to prevent the depositing during reasonable times on any wharf, any goods, wares and merchandise unladen from or about to be shipped on board of any vessel or ship; or for the purpose of being stored,—always allowing a sufficient passage-way for cars, wagons and drays. This did not prevent any person from erecting or enclosing any part of the wharf lying landward of the low water mark or tideway of the River Delaware.

The Governor was required to appoint and commission a person of skill to be Harbor Master of the Port of Philadelphia. His duty was to enforce and superintend the execution of all of the Laws of the Commonwealth, and of all by-laws and rules and regulations of the city or of the Wardens of the Port of Philadelphia. He was authorized to appoint deputies to assist him and in full compensation for his services, he was entitled to recover and receive from the master, captain, owner or consignee of every ship or vessel arriving at the Port, the sum of one dollar.

2.—*The Appropriation of 1889 for Harbor Improvements.*

Whereas, The Congress of the United States, recognizing the importance of the preservation and permanent improvement of the harbor of the Port of Philadelphia, appropriated for the beginning of the work in 1888, the sum of \$500,000 upon the condition that the title to the lands of certain islands necessary to be removed, should be acquired and vested in the United States without charge to the National Government beyond the sum of \$300,000, and it appearing that this sum was insufficient to procure and vest title as aforesaid;

And whereas, The improvement of the harbor of the Port of Philadelphia is of essential importance to the people of the entire Commonwealth; therefore,

It is enacted by Act No. 330, approved by the Governor May 31st, 1889, That the sum of \$200,000, be specifically appropriated for the purpose of aiding in the acquisition of and vesting in the United States the title to Smith's Island, Windmill Island and such other islands, or parts thereof, as may be necessary to be removed in connection with the improvement of the Port of Philadelphia by the Government of the United States.

3.—*The Appropriation of 1905 for Deepening the River.*

Act No. 243, approved by the Governor on May 8, 1905, made an appropriation of \$375,000 for the deepening and improving of the channel of the Delaware River, between the city of Philadelphia and Delaware Bay.

At that time the Government of the United States was engaged in the work of deepening the said channel. To assist in the prosecution of the work, the Pennsylvania General Assembly appropriated the \$375,000 aforesaid, to be paid into the treasury of the City of Philadelphia, and to be expended in the said work under the supervision of the Department of Public Works, Bureau of Surveys, of said city, in accordance with the plan thereof, subject to the approval of the War Department; *Provided*, That the said City of Philadelphia shall appropriate a like amount for the purposes aforesaid.

4.—*The Laws of 1907 Relative to Harbor Master and Wharves, Docks and Ferries.*

(a) There were many amendments and supplements to the Law of 1803, and finally Act No. 323, approved June 8th, 1907, abolished the Board of Wardens for the Port of Philadelphia and the offices of Harbor Master and Master Warden of the Port of Philadelphia, and transferred the property belonging to these officials to the Board of Commissioners of Navigation for the River Delaware and its Navigable Tributaries.

(b) Act No. 322, approved June 8, 1907, established a Board of Commissioners of Navigation for the River Delaware and its Navigable Tributaries; regulated their jurisdiction over ships, vessels and boats, and wharves, piers, bulk-heads, docks, slips and basins; exempted Philadelphia from certain of these provisions and made an appropriation therefor.

The said Board of Commissioners of Navigation consists of five members—one of whom shall be the Director of the Department of Wharves, Docks and Ferries for the City of Philadelphia, who shall be President thereof; one of whom shall be appointed by the Mayor of Philadelphia, and one by the Mayor of Chester, from such commercial bodies as the councils of said cities may designate; one of whom shall be elected by the council of the city of Chester, and one of whom shall be elected by the Burgess and Council of the Borough of Bristol.

The Commissioners are empowered to employ necessary help and make rules for regulating, stationing and anchoring ships, vessels and boats in the River Delaware and its navigable tributaries or at the wharves, piers or bulk heads, or in the docks, slips or basins, extending into or on the river and its navigable tributaries; for removing from time to time, ships, vessels and boats, in order to accommodate and make room for others, or for admitting river craft to pass in and out of the docks, slips and basins, and for compelling the masters and captains of ships, vessels and boats to accommodate each other, so that ships, vessels, and boats shall, for a reasonable time, be entitled to berths next to the wharves, piers, and bulk-heads, until they have landed or loaded their cargoes.

The Commissioners have power to survey and make soundings to ascertain the capacities of the aforesaid river and its navigable tributaries, and to prepare plans and to keep records thereof. They may regulate, fix and establish bulk-head and pier-head lines, and the distance between piers, subject to the regulation of the United States Government; to adopt and promulgate rules and regulations for the construction, extension, alteration, improvement, and repair of wharves, piers, bulkheads, docks, slips, and basins; but for territory outside of the City of Philadelphia only.

It is the duty of the President of the Commission to enforce the laws of the Commonwealth and the rules and regulations promulgated by the said Commission pertaining to the above mentioned matters; but the Commissioners shall not have jurisdiction within the City of Philadelphia for the purpose mentioned in the preceding paragraph.

Whenever any person shall desire to construct, extend or alter any wharf or pier, or to erect, extend, alter, or improve any other harbor structure into or on the aforesaid river and its navigable tributaries, such person shall make application in writing and file in the office of the President of the Commission the plans and specifications thereof: Wherefore a hearing, duly advertised, shall be given, and when approved, a license shall be issued for the erection, construction, extension, alteration, or improvement for which application was made: *Provided*, This jurisdiction shall not apply to the City of Philadelphia territory.

Whenever the owner or lessee of any wharf, pier or bulkhead shall fail to keep and maintain the adjoining dock cleaned and free from obstructions, the President of the Commission, upon default for 30 days after the service of notice, may clean and free said dock from obstructions and apportion the expense and collect the cost by filing liens therefor, in the name of the Commonwealth of Pennsylvania: *Provided*, That the Commissioners shall not have such jurisdiction within the City of Philadelphia.

The Board of Commissioners may regulate the services and fix the maximum rates for wharfage, crantage and dockage; but only outside of the city of Philadelphia.

If any person or persons whomsoever, shall cast or place or leave in position where the same may be washed or drifted into the tide-way of the River Delaware, or into the River Schuylkill from the lower falls thereof to its junction with the River Delaware, any ballast, cinders, ashes, dirt, refuse, or any heavy article

whatever, he or they so offending, for any offense, shall pay a sum not exceeding one hundred dollars, to be sued for and recovered, with the costs of suit, for the use of the Commonwealth.

Upon information of the sinking of any canal-boat, barge, or other vessel, in the channel-way of the tide-waters of the River Delaware or its navigable tributaries, or in any of the docks thereof, the President of the Commissioners shall give notice to the owner, master or other agent having charge thereof, to raise and remove such obstruction within ten days under penalty of one hundred dollars, to and for the use of the Commonwealth of Pennsylvania; and in case of refusal or neglect of the parties interested, as aforesaid, to raise and remove any such obstruction, it is the duty of said President to have it raised and removed at the expense of the owner, etc.; and the boat, barge or other vessel, together with the cargo thereof, shall be subject to a lien, and the President may sell at public auction for cash all such property or so much thereof as is necessary to pay all expenses incurred. Should the sum realized from the sale be insufficient, the President may sue for the amount of such deficiency in the name of and for the benefit of the Commonwealth; and it is the duty of the Attorney General of the Commonwealth to institute and prosecute such suits.

The Commissioners make an annual report to the Governor of the State.

The General Assembly transferred \$53,324, appropriated in the general appropriation bill to the harbor offices and Port Warden at Philadelphia, to the said Board of Commissioners of Navigation, in addition to its receipts, for necessary expenses in the performance of its duties.

(c) Act No. 317, approved June 8, 1907, vests the authority over the pilots and pilotages in the Bay and River Delaware in the Board of Commissioners of Navigation.

(d) The growing commerce of Pennsylvania, and the substantial improvement being made by the government of the United States in the channel-ways of the rivers and harbors, made it desirable in 1907 for the City of Philadelphia to have enlarged and extended powers for the construction and development of wharves, docks and harbors.

Act No. 321, approved June 8th, 1907, established a Department of Wharves, Docks and Ferries, which shall be under the charge of a Director. He is appointed by the Mayor for a term of 4 years.

The Director appoints one deputy director, a secretary, as many dock masters and such other officers, clerks and employees as may be necessary; and shall fix the compensation and prescribe the duties of all persons appointed by him. At least one of the dock masters must be a competent civil engineer, one a master mariner and one a licensed pilot.

The Director has power to make surveys and soundings and plans; to regulate, fix and establish bulkheads and pierhead lines, and the distance between piers, subject to the regulations of the United States government; to adopt and promulgate rules and regulations for the construction, extension, alteration, improvement and repair of wharves, piers, bulkheads, docks, slips and basins within the limits of Philadelphia; and to make such recommendations to councils as to him shall seem proper for the improvement and development of the water-front of said city.

The Director has charge, control and supervision of all the wharves, piers, bulkheads, docks, slips, basins, structures thereon and storage property belonging to the city, including water fronts, lands under the water and structures thereon,

etc.; and of the repairing, building, rebuilding, maintaining, altering, strengthening and protecting said property, and every part thereof; and of all cleaning, dredging and deepening in and about the same.

The Director has authority to acquire by purchase such unimproved marsh lands, within the city, as may be reclaimable between the low-water line and the high-water shore line of the rivers, bays, lakes and navigable waters, and to reclaim, fill in and improve said marsh lands and construct thereon wharves, piers, docks, slips, basins and storage facilities; and may lease or sell such part or parts of said lands as cannot be so improved.

The Director may acquire, by purchase, such wharves, piers, bulkheads, docks, slips, basins and storage facilities appurtenant thereto, lands, property, rights, easements and privileges, within the limits of Philadelphia, as may be required for the purposes of commerce and navigation; and he may erect on such lands, piers and bulkheads, such structures and buildings as may be necessary for the proper and convenient use of such wharves, piers and bulkheads, for the storage of incoming or outgoing goods, wares, or merchandise; and he has the power to make all rules necessary for the government of such storage facilities and fix all rates and charges for their use and occupation.

Whenever any person shall desire to construct, extend, or alter any wharf, etc., he shall make written application to the Director, accompanied with plans and specifications, and after having duly advertised, the Director may approve the plans and issue a license for the erection, construction, extension, alteration, or improvement.

The Director is charged to keep and maintain the docks cleaned and free from obstruction under substantially the same condition provided by the Board of Commissioners of Navigation for the work beyond the city limits.

The Director was authorized to regulate the services and fix maximum rates and charges for ferriage, to be imposed and collected by all companies and individuals operating ferries wholly within the limits of the city; and to regulate the services and fix maximum rates for wharfage, cramage and dockage, whether the service is performed by the owners of said wharves, piers and docks, or by the said city, under the provisions of Sections 13 and 14 of said Act of 1907.

Whenever the Director shall deem it expedient to erect, construct, extend, alter or improve any public wharf, pier or bulkhead, and in connection therewith it shall become necessary to acquire lands, leaseholds, easements and other property rights adjoining such wharf, pier or bulkhead, for which no price can be agreed upon, the Director may enter upon and occupy such property; and a jury of viewers may be appointed to assess damages.

The Director may lease for a period not to exceed 10 years, storage facilities, wharves, piers, bulkheads, docks, slips, and basins belonging to the city.

The councils of the city are enjoined to appropriate annually the funds necessary for the maintenance and operation of the said Department of Docks, Wharves and Ferries.

5.—*The Appropriation of 1907, for Port Improvements.*

Act No. 664, approved by the Governor on June 13th, 1907, appropriated \$250,000 to the city of Philadelphia, upon the condition that said city appropriate a like or greater sum, for the improvement of her water-front and dockage system, and the reclaiming of waste lands.

6.—*The Appropriation of 1911.*

An appropriation act of the General Assembly of 1911, approved June 15, 1911, specifically appropriated to the Department of Wharves, Docks and Ferries of Philadelphia, the sum of \$450,000 for dredging in the Delaware and Schuylkill rivers, within the State; for the improvement of harbor facilities, dockage systems, reclaiming waste land; the purchase or condemnation of waste land, or lands that are practically waste; the purchase of desirable sites upon which to erect piers, and for the construction of piers, bulkheads, or other harbor improvements; for the dredging of docks and for the removal of shoals in the Delaware River, between the channel and the pierhead line, and the pierhead and bulkhead lines, along the Delaware and Schuylkill rivers within the limits of the State of Pennsylvania.

7.—*The Laws and Appropriations of 1913, Relative to Port Improvements.*

(a) Act No. 750, approved July 25, 1913, appropriated the sum of \$250,000 to the Department of Wharves, Docks and Ferries of Philadelphia, for purposes similar to the 1911 appropriation. The law provides as follows:

"The moneys so appropriated shall only be expended as authorized and directed by the councils of the City of Philadelphia. A competent engineer shall be appointed by the Governor, for a term of four years at a salary of \$4,000 per year, payable out of said appropriation. Said engineer shall assist and co-operate in the said work with the director of the Department of Wharves, Docks and Ferries of the city, and report to the Governor from time to time as to the expenditure of said moneys. No such moneys shall be drawn out of the State Treasury except upon warrants drawn by the Auditor General, upon requisition by the Director of the Department of Wharves, Docks and Ferries of said city."

(b) Act No. 436 approved July 22nd, 1913, contemplates the Commonwealth's appropriation for building retaining structures adjoining the banks of navigable streams in Philadelphia for the purpose of protecting the channel of such streams.

The law reads as follows:

"Section 1. Be it enacted, &c., That the directors of the Department of Wharves, Docks and Ferries, in any city of the first class, shall have authority, after the appropriation by councils, of said city, or by the Commonwealth of Pennsylvania, of the money required therefor, to erect and construct retaining structures adjoining the banks of navigable streams located within its corporate limits, for the purpose of protecting the channel of such streams; and when any such retaining structures shall have been erected or constructed the cost thereof per foot shall be filed in the office of said Director, and no riparian owner, lessee or licensee, shall use any such retaining structure for the purpose of constructing, extending, altering, improving or repairing any wharf, or other building in the nature of a wharf, or other harbor structure, or for other wharf purposes, without having previously paid to the said director of the city in which such retaining structure is erected or constructed the cost of erecting so much of said retaining structure as is so used; and any such person who shall use any such retaining structure as aforesaid, before the cost thereof has been paid to the said city a penalty of twenty-five dollars per day for every day on which such retaining structure shall be so used, to be collected as debts of a similar nature are now collected. All money paid to the director under the provisions of this act shall be paid by him into the city treasury, to be used by the said city only for the purpose of developing, extending and improving the wharves owned by the said city."

(c) Act No. 460, approved July 24, 1913, provides that in addition to the existing powers in respect to public wharves, the municipalities of this Commonwealth shall have power to erect and maintain market-houses and terminal sheds or stations on said wharves, for the receipt and distribution of freight, express,

and other matter hauled by boats, railroads and street cars. Said power includes the right to construct railroad and street car tracks or other facilities on said wharves to provide for the convenient handling of such freight or express matter, and the right to collect rents, tolls or charges for the use of such market-houses, terminal stations, tracks and other facilities.

(d) The General Assembly of 1913, adopted a joint resolution proposing an amendment to Section 8, article 9 of the Constitution of the Commonwealth of Pennsylvania, which will come before the General Assembly of 1915, and if these passed, then go to the people for ratification. Section 8 as so amended will read:

"The debt of any county, city, borough, township, school district, or other municipality or incorporated district, except as herein provided, shall never exceed seven per centum upon the assessed value of the taxable property therein, nor shall any such municipality or district incur any new debt, or increase its indebtedness to an amount exceeding two per centum upon such assessed valuation of property, without the assent of the electors thereof at a public election in such manner as shall be provided by law; but any city, the debt of which now exceeds seven per centum of such assessed valuation, may be authorized by law to increase the same three per centum in the aggregate, at any one time, upon such valuation; except that any debt or debts hereinafter incurred by the city and county of Philadelphia for the construction and development of wharves and docks, or the reclamation of land to be used in the construction of a system of wharves and docks, as public improvements, owned or to be owned by said city and county of Philadelphia, and which shall yield to the city and county of Philadelphia current net revenue in excess of the interest on said debt or debts and of the annual installments necessary for the cancellation of said debts or debt, may be excluded in ascertaining the power of the city and county of Philadelphia to become otherwise indebted: *Provided*, That such indebtedness incurred by the city and county of Philadelphia shall not at any time, in the aggregate, exceed the sum of \$25,000,000. for the purpose of improving and developing the port of the said city and county, by condemnation, purchase, or reclamation or lease of land on the banks of the Delaware or Schuylkill rivers and land adjacent thereto; the building of bulkheads, and the purchase or construction or lease of wharves, docks, sheds and warehouses and other buildings and facilities necessary for the establishment and maintenance of railroad and shipping terminals along the said rivers; and the dredging of the said rivers and docks: *Provided*, That the said city and county shall, at or before the time of so doing, provide for the collection of an annual tax sufficient to pay the interest thereon, and also the principal thereof within fifty years from the incurring thereof."

8.—*Summary of State Appropriations for Navigation and Harbor improvements.*

By a decree of the Supreme Court of the United States the Harbor Master and Port Warden of the Port of Philadelphia were prohibited from collecting fees, as heretofore, from vessels entering said port, which fees paid the salaries of said officers, therefore, by Act No. 957, approved April 15th, 1869, these officers each received \$2,500 annually, to be paid out of the State treasury beginning January 1st, 1869.

Eight years after the above provisions for salaries, the duties of Harbor Master having greatly increased, it became necessary to have deputies to assist him in the performance of his duties, to promote the commercial interests of Philadelphia; therefore, Act No. 6, approved March 22nd, 1877, appropriated \$3,000 for such additional expenses for one year. In the following tabular statement appears the State appropriations for the conducting of the work of the Harbor Master and Port Warden for the year 1877 to 1905, inclusive, when their respective duties were taken over by the Board of Commissioners of Navigation, as hereinbefore explained. The subsequent State appropriations went to the said Commissioners of Navigation.

STATE APPROPRIATIONS FOR THE REGULATION OF NAVIGATION
AND THE IMPROVEMENT OF HARBOR FACILITIES IN THE PORT OF
PHILADELPHIA.

Year.	For Operating Expenses.	For Construction Expenses.
1877,	\$3,000	.....
1878,	4,000	.....
1879,	9,000	.....
1881,	15,000	.....
1883,	10,000	.....
1885,	22,000	.....
1887,	23,000	.....
1889,	22,000	\$200,000
1891,	23,000	.....
1893,	25,500	.....
1895,	28,000	.....
1897,	28,000	.....
1899,	28,700	.....
1901,	53,900	.....
1903,	65,000	.....
1905,	52,464	375,000
1907,	53,324	250,000
1909,	63,000	.....
1911,	63,000	450,000
1913,	63,000	250,000
		\$1,525,000

9.—*The Health Law of 1818.*

The State of Pennsylvania has from the earliest time exercised supervision over and provided officers and made liberal appropriations to protect the public health at the Port of Philadelphia. In 1818, the Senate and House of Representatives of the State established a health office to secure the city and Port of Philadelphia against contagious diseases. A Board of Health was created to serve without compensation, and vested with authority to make general rules and regulations for the government of the Lazaretto and the vessels, cargo and persons there detained or under quarantine, and for the government of public hospitals. The Governor was required to appoint a Lazaretto physician, and a Port Physician, one health officer and one quarantine master, all of whom shall be under the direction and control of the Board. It was the duty of the Board to abate nuisances in the streets and alleys and along the wharves and docks or in any other part of the city of Philadelphia, the district of Southwark, and the townships of the Northern Liberties, Moyamensing and Penn. The officers were to receive a salary and for defraying the expenses incurred under the provisions of the act, the Board was authorized to levy and collect by tax at the same rates and under the same regulations as the county rates are or may be levied and collected, such sums annually as shall be deemed necessary.

10.—*The Health Law of 1893.*

Under date of February 15, 1893, the Congress of the United States enacted a general quarantine law, to be administered by Federal officers stationed in foreign countries and by the Federal Marine Hospital service acting as quarantine officers at stations on or near the navigable waters of United States. There was reason to believe that the Federal quarantine for the Delaware Bay and River would be fully equipped and in effective operation during the summer of 1893; and, whereas,

the multiplication of quarantine visits and inspections on board ship during one and the same entry into the port of Philadelphia would interfere with the expeditious movement of maritime commerce, by Act of General Assembly No. 257, approved June 5, 1893, the Governor of Pennsylvania was authorized to suspend operations of State quarantine as provided in the Act of 1818, and its supplements and other quarantine laws of the State, and to establish a new quarantine station at some suitable place on the waters of the Delaware River, and to abandon the present Lazaretto and turn the same over to the city of Philadelphia.

Said law of 1893 established a State Quarantine Board of the Port of Philadelphia. The Board was constituted as follows: The President of the College of Physicians of Philadelphia, the Secretary of the State Board of Health, the President of the Philadelphia Maritime Exchange, the Health Officer of the Board, the Quarantine Physician of the Board, a member to be appointed by the Mayor of Philadelphia and a member to be appointed by the Governor of Pennsylvania, making seven in all.

The Board may make such rules and regulations not inconsistent with the laws of United States and of Pennsylvania as necessary for the government and management of the quarantine station and for the detention of vessels, their crews and passengers, the disinfection of vessels and their crews, passengers, baggage and cargo.

The Governor is required to appoint one physician who shall be denominated the Quarantine Physician. He is a member of the Board and the executive officer of the quarantine station. His duty is to enforce all laws, rules and regulations as may be provided by the Board and his salary and that of his deputies shall be paid by the State.

The Health Officer appointed in pursuance of Act 1818, shall establish a public office at or within three squares of the custom House in Philadelphia, to be known as the Quarantine Office to be open throughout the year from 9 A. M. until 5 P. M., Sundays and holidays excepted, whereat all masters and captains of vessels may deliver the health certificate required by law. All fees collected by him shall be paid over monthly to the State. He also receives a salary paid by the State.

When the Quarantine Physician shall be satisfied that all vessels coming from any port or place outside the Commonwealth may be admitted into the port without danger to the health of the people of the Commonwealth, he shall give a certificate permitting the vessel to proceed, which certificate the captain or master shall present at the quarantine office in the city.

Whenever the State quarantine service is suspended by the Governor, the master of every vessel arriving from a port without this Commonwealth, excepting ports on the Delaware River above Reedy Island, shall appear at the quarantine office in Philadelphia, and show that a certificate of health has been granted to him by the officers in charge of the Federal Quarantine Station and that the same has been deposited with the collector of the port. If it shall appear that any contagious or infectious disease has developed on any vessel after her release from the Federal Quarantine, the Quarantine Physician may order such vessel back to said Federal Quarantine Station for further inspection and treatment.

The expense and charge of boarding, lodging, medicines, nursing and maintenance, and other necessities provided for the persons landed and sent to the said State Quarantine Station, and all other expenses, salaries or wages, incident to the maintenance of said quarantine station, and of the persons detained there, and of the tug boats, and of the said quarantine office in the city of Philadelphia, and of the office of the State Quarantine Board shall be paid by the Commonwealth.

From and after July 1st, 1893, the offices of Lazaretto Physician and Quarantine Master ceased to exist.

Port of Philadelphia for the purpose of the act creating the State Quarantine Board includes all the counties that abut upon the navigable waters of the Delaware River and the navigable tributaries thereof within Pennsylvania.

11.—*State Appropriations for Quarantine Board.*

In 1891, a Commission was appointed to select a site for the proposed new State Quarantine Station and an appropriation of \$1,000 was provided therefor by the General Assembly. The State appropriations for the maintenance of the State Quarantine Board and for the work of the Quarantine Physician and Health Officer for the years 1893 to 1913, inclusive, are shown in the following tabular statement:

APPROPRIATIONS MADE BY THE GENERAL ASSEMBLY AND APPROVED BY THE GOVERNOR OF PENNSYLVANIA FOR THE STATE QUARANTINE BOARD OF THE PORT OF PHILADELPHIA.

Year.	Amount.
1891,	\$1,000 00
1893,	59,400 00
1895,	64,200 00
1897,	99,200 00
1899,	79,200 00
1901,	144,616 60
1903,	108,200 00
1905,	80,040 00
1907,	75,540 00
1909,	80,540 00
1911,	94,640 00
1913,	96,010 00

12.—*The Pennsylvania Nautical School Appropriations.*

The Pennsylvania Nautical School was established by Act of April 17th, 1889. It was governed by a board of six directors, three of whom were appointed by the Governor of the State, and three by the Mayor of the City of Philadelphia.

The Board of Directors was authorized and directed to provide and maintain a nautical school for the education and training of pupils in the science and practice of navigation; to furnish accommodation on board a proper vessel for said school and make all needful rules and regulations therefor, and to prescribe the government and discipline therefor, and the terms and conditions upon which pupils shall be received and instructed therein and discharged therefrom, and provide in all things for the good management of said nautical school.

The Board had the power to purchase the books and apparatus, stationery and other necessary or expedient to enable said school to be properly and successfully conducted, and to cause the said school, or the pupils or part of the pupils thereof, to go on land or vessel or vessels in the harbor of Philadelphia, and take cruises in or from said harbor for the purpose of obtaining a practical knowledge in navigation and the duties of mariners.

The Board was authorized to receive from the United States Government such vessel or vessels as the Secretary of the Navy may detail for the use of the school.

The first vessel detailed by the Secretary of the Navy upon the application of the Governor of the State of Pennsylvania was the U. S. sloop of war Saratoga, which was recently withdrawn as unfit for further employment, after 18 years of usefulness. The second to be designated was the U. S. Cruiser Adams which has undergone alterations and been made suitable for schoolship purposes.

The city of Philadelphia appropriated annually between \$15,000 and \$20,000. The State of Pennsylvania appropriated between \$10,000 and \$15,000 per annum.

APPROPRIATIONS MADE BY THE STATE AND THOSE MADE BY THE CITY OF PHILADELPHIA FOR THE PENNSYLVANIA NAUTICAL SCHOOL OF PHILADELPHIA.

Year.	State For 2 Year Period.	City For Same Period.
1889,	\$20,000	\$30,000
1891,	26,000	40,000
1893,	26,000	40,000
1895,	24,000	37,000
1897,	24,000	37,000
1899,	24,000	40,000
1901,	24,000	40,000
1903,	24,000	40,000
1905,	24,000	40,000
1907,	24,000	40,000
1909,	24,000	40,000
1911,	30,000	30,000
1913,		

The school automatically ceased to exist in 1913, for lack of appropriations by the city and by the State.

13.—Summary of all State Appropriations for or in Connection with the Port of Philadelphia.

STATE APPROPRIATIONS.

Year.	Navigation and Im- provement of Harbor Facilities.		State Quarantine Board of the Port of Philadelphia.	Pennsylvania Nautical School of Pennsylvania.	Total.
	For Operating Expenses.	For Construction Expenses.			
1877,	\$3,000				\$3,000
1878,	4,000				4,000
1879,	9,000				9,000
1881,	15,000				15,000
1883,	10,000				10,000
1885,	22,000				22,000
1887,	23,000				23,000
1889,	22,000	\$200,000		\$20,000	242,000
1891,	23,000		\$1,000	26,000	50,000
1893,	25,500		59,400	26,000	110,900
1895,	28,000		64,200	24,000	116,200
1897,	28,000		98,200	24,000	151,200
1899,	28,700		79,200	24,000	131,900
1901,	53,900		144,616	24,000	222,516
1903,	65,000		108,200	24,000	197,200
1905,	52,464	375,000	80,040	24,000	531,504
1907,	53,324	250,000	75,540	24,000	402,864
1911,	63,000	450,000	94,640	30,000	637,640
1913,	63,000	250,000	96,040		409,040
	\$654,888	\$1,525,000	\$382,616	\$294,000	\$3,456,504

FEDERAL IMPROVEMENT OF RIVERS AND HARBORS IN THE PHILADELPHIA DISTRICT AND APPROPRIATIONS THEREFOR.

The Federal improvement of rivers and harbors in the Philadelphia district is divided, for purposes of this report, into four projects, namely:

- 1—Delaware River—Philadelphia to the Sea,
- 2—Philadelphia Harbor Improvement,
- 3—Delaware River—Philadelphia to Trenton,
- 4—Harbor of Refuge—Delaware Bay.

1.—*Delaware River, Philadelphia to the Sea.*

The Delaware River has its source in Delaware County, New York State, is about 315 miles long, flows in a general southerly direction, and empties into Delaware Bay.

Trenton is the actual and natural head of navigation for vessels and other craft. Tide water extends as far as Trenton and the mean range of tide at this point is 4.2 feet. The river is navigable for rafting and logging for a distance of about 214 miles above Trenton.

Philadelphia is 30 miles below Trenton and 55 miles above the mouth of the river. The distance by water from Philadelphia Harbor to the harbor of refuge, Delaware Bay, is about 101 miles. The draft that can be carried from the ocean through Delaware Bay (50 miles) to the mouth of the river is 30 feet at mean low-water. The accepted point of division between Delaware Bay and River is at Liston Point, in the Bay about 8 miles below the mouth of the river. From the Point to the ocean the minimum usable low-water depth is 40 feet.

Originally the obstruction reduced the depth of the river channel so that it was available for ocean-going vessels of medium draft only.

Prior to 1885, so the U. S. Engineers Reports show, the dredging was done under appropriations for special localities.

The first permanent and systematic improvement of the river between Philadelphia and the Sea, was commenced in 1885. This was the **26 foot deep channel project**, width 600 feet from near Allegheny Avenue, Philadelphia, to deep water in Delaware Bay.

The second project was adopted in March, 1899. It provided for a channel 30 feet deep at mean low water, width of 600 feet from Christian Street to the Bay. This work was completed March, 1911.

The existing project for the improvement of this section of the river, was adopted June, 1910. It provides for a channel 35 feet deep at mean low water, 800 feet wide in the straight parts, 1,200 feet wide at Bulkhead Bar and 1,000 feet wide at other bends, and for the construction of dykes to control the tidal flow. The estimated cost is \$11,000,000 in round numbers and an annual cost of \$300,000 for maintenance.

"The maximum draft that could be carried on June 30, 1914, over the shoalest part of the portion of the river embraced in this improvement was 30 feet at mean low water. The mean range of tide varies from 5.3 feet at Philadelphia to 6 feet at deep water at the head of Delaware Bay. A channel of the depth and width specified in the adopted project has been completed, or the work is nearing completion, from Greenwich Point, at the lower end of Philadelphia Harbor, to a point a little above Wilmington, Del., a distance of about 19.9 miles."

The amount expended under all previous projects for improving the river below Philadelphia, from 1836, to the time of taking up the existing project, excluding, of course, the sum expended in the improvement of Philadelphia Harbor, is stated by the Federal engineers to have been \$10,176,002.08.

The appropriations were substantially as follows:

Appropriations—Delaware River.

Total from 1836 to Dec. 31, 1902,	\$4,204,000 00	
March 3, 1903,	1,400,000 00	
April 28, 1904,	1,000,000 00	
March 30, 1905,	500,000 00	
June 30, 1906,	1,000,000 00	
March 2, 1907,	895,000 00	
May 27, 1908,	375,000 00	
March 3, 1909 (allotment March 17, 1909),	390,000 00	
March 4, 1909,	125,000 00	
	<hr/>	\$9,889,000 00
June 25, 1910,	\$800,000 00	
Feb. 29, 1911,	800,000 00	
July 25, 1912,	1,300,000 00	
Aug. 24, 1912,	450,000 00	
March 4, 1913,	1,750,000 00	
June 23, 1913,	250,000 00	
Miscellaneous up to June 30, 1913,	28,864 51	
	<hr/>	5,378,864 51
		<hr/>
		\$15,267,864 51
		<hr/>

2.—Philadelphia Harbor Improvement.

A project for the improvement of Philadelphia Harbor adopted Aug. 11, 1888, was completed Jan. 10, 1898, the resulting channel having a least depth of 26 feet at mean low water, except at one locality just below Cramp's Ship-yard, over which the depth was slightly less than 26 feet, with a width varying from 1,015 to 1,850 feet, extending from a point opposite Morris Street, Philadelphia, to the Pennsylvania Railroad bridge, a distance of 6.2 miles.

The total amount expended in this improvement, including survey of the locality and the acquisition of land, was reported as \$3,945,424.75.

Appropriations.

Total to Dec. 31, 1902,	\$3,940,000 00
Allotment 1905,	10,000 00
	<hr/>
	\$3,950,000 00
	<hr/>

3.—Delaware River—Philadelphia to Trenton.

Prior to 1910, on comprehensive project had even been adopted for the improvement of this part of the river. Work had been done at various times since 1872 at different localities, with a view to obtaining a depth of 7 feet at mean low

water and a width of 200 feet. Under the general project for improving Philadelphia Harbor, a channel 26 feet deep was dredged through Five-Mile Bar between 1888 and 1898.

The amount expended in the improvement of the Delaware River between Philadelphia and Trenton prior to the adoption of the existing project and exclusion of the sum expended in the harbor improvement was \$197,623.25.

The existing project for the improvement of this section of the river was adopted June 25, 1910, and provides for a channel 200 feet wide and 12 feet deep at mean low water, at an estimated cost of \$360,000 and an annual cost of \$20,000 for maintenance.

The work was substantially completed in May, 1913. The total amount expended in connection with the project up to June 30, 1914, was reported to be \$315,977.10. Therefore, the total amount expended on all projects pertaining to the Delaware River from Allegheny Avenue, Philadelphia to Trenton is as follows:

Prior to existing project,	\$197,623 25
Existing project to date,	315,977 10
	<hr/>
	\$513,600 35
	<hr/>

The completion of the channel has enabled sea-going vessels of medium draft to reach the manufacturing plants along the line of the improvement. It has enabled the regular line of steamers plying between Philadelphia and Trenton to make faster time, to run on schedule and to increase business.

The maximum draft that could be carried on June 30, 1914, over the shoalest part of the locality under improvement was 11 feet at mean low-water (opposite Mud Island).

Appropriations.

Total from 1836 to Dec. 31, 1902,	\$124,500 00
March 2, 1907 (Perriwig Bar),	50,000 00
March 2, 1907 (Allotments near Bordentown),	10,000 00
March 3, 1909 (Perriwig Bar),	1,500 00
March 3, 1909 (Sewer Shoal near Trenton),	15,000 00
June 25, 1910,	100,000 00
March 4, 1911,	160,000 00
August 24, 1912,	70,000 00
March 4, 1913,	20,000 00
	<hr/>
	\$551,000 00
Sales Receipts,	16 04
	<hr/>
	\$551,016 04
	<hr/>

4.—Harbor of Refuge—Delaware Bay.

The great value of this Harbor of Refuge, on the Delaware Bay, near the ocean is due to the fact that it is located about equal distance from New York, Philadelphia and the Chesapeake capes, and affords a haven of refuge, or a port of call for practically the entire shipping of the North Atlantic Coast. The harbor is largely used by vessels awaiting orders or charters.

It has a protected anchorage area of 552 acres, with a minimum low-water depth of 30 feet, and an additional area of 237 acres with a minimum low-water depth of 24 feet.

The work on the breakwater was commenced in 1897, and completed in 1901. The sub-structure of the breakwater has a length of 8,040 feet and the superstructure a length of 7,950 feet. The cost of constructing the breakwater and the ice piers forming the harbor of refuge was \$2,238,205.34.

Appropriations.

Total as per H. Doc. No. 423, 57th Congress,.....	\$2,239,334 00
June 25, 1910,	8,000 00
February 27, 1911,	8,000 00
	<hr/>
	\$2,255,334 00
	<hr/> <hr/>

5.—*Summary of Federal Appropriations for Navigation and Harbor Improvement.*

The Federal appropriations up to June 30, 1914, may be summarized as follows:

Delaware River—Philadelphia to the Sea,	\$15,267,864 51
Philadelphia Harbor,	3,950,000 00
Delaware River—Philadelphia to Trenton,	551,016 04
Harbor of Refuge—Delaware Bay,	2,255,334 00
	<hr/>
Grand total,	\$22,024,214 55
	<hr/> <hr/>

CITY APPROPRIATIONS FOR HARBOR AND PORT IMPROVEMENT.

1.—*Prior to 1907.*

The Department of Wharves, Docks and Ferries was created and established July 1st, 1907. Prior to that time and in fact from 1890 to 1907, the city of Philadelphia appropriated \$5,718,743 for harbor improvements as follows:

Port Wardens (Dredging, etc.),	\$217,053 00
City Property (Dredging, Repairs, Piers, etc.),	217,337 00
Bureau of Surveys:	
(Dredging Delaware River),	1,164,475 00
(Dredging Schuylkill River),	773,629 00
(Widening Delaware Ave.),	2,152,706 00
Bureau of City Ice Boats to 1907,	984,890 00
Removal of Smith and Windmill Island,.....	208,653 00
	<hr/>
Total,	\$5,718,743 00
	<hr/> <hr/>

2—Since 1907.

In addition to general funds appropriated for operation, the following loan moneys have been appropriated by the city since July 1, 1907, for harbor improvements:

To the Department of Wharves, Docks and Ferries:

March 12, 1909, for reclamation of land and piers construction,.....	\$1,000,000 00
May 27, 1909, for bulkhead along Delaware Ave.,	10,000 00
July 19, 1909, for improvement of Delaware and Schuylkill Rivers,.....	400,000 00
July 29, 1910, for repairs to piers and city ice boats,.....	43,010 00
July 19, 1911, for Vine St. pier and new Dock St. pier,.....	600,000 00
June 4, 1912, for maintenance of boats,.....	7,000 00
May 1, 1913, for land for wharves, etc.,	1,600,000 00
June 22, 1914, for purchase of ground, and preliminary construction of pier at foot of McKean St., Delaware River,.....	500,000 00
Total to Dept. W., D. & F.,	<u>\$4,160,010 00</u>

To the Department of Public Works:

Feb. 9, 1907, for widening of Delaware River Ave.,.....	\$500,000 00
Feb. 25, 1913,	250,000 00
Dec. 31, 1913,	10,000 00
June 30, 1914, Funds available for carrying forward So. Philadelphia track elevation and terminal improvement work,	1,000,000 00
Total available to supply public works,	<u>1,760,000 00</u>
Total,	<u><u>\$5,920,010 00</u></u>

3.—Summary of City Appropriations for Harbor and Port Improvements.

Prior to 1907,	\$5,718,743 00
Since 1907,	5,920,010 00
Total,	<u><u>\$11,638,753 00</u></u>

GRAND SUMMARY OF FEDERAL, STATE AND CITY APPROPRIATIONS FOR THE PORT.

Before 1890, moneys, appropriated by the city of Philadelphia for river improvement purposes, were infrequent and of small amount. The total appropriations on the part of the city for the improvement of the Port up to June 30, 1914, were approximately \$12,000,000. The additional sum appropriated by the State of \$1,525,000 for construction work, makes a grand total of \$13,525,000 which the city has had for the following undertakings, among others:

- a—Removal of Smith and Windmill islands (from the Delaware River between Philadelphia and Camden).
 b—Widening Delaware Avenue and incidental changes (including extending city piers to the pierhead line).
 c—Construction of new steamship piers.
 d—Construction and maintenance of city ice boats.
 e—Purchase and maintenance of municipal dredging plant.
 f—Dredging of river channels and their improvements.

EXPENDITURES AUTHORIZED BY APPROPRIATIONS OR ACTUALLY MADE BY THE FEDERAL, STATE AND CITY GOVERNMENTS FOR IMPROVING AND MAINTAINING AND IMPROVING THE HARBOR OF PHILADELPHIA AND DELAWARE RIVER TO THE SEA, UP TO JUNE 30TH, 1914.

Year.	Harbor of Philadelphia.			Delaware River.
	Federal construction and maintenance.	State construction.	City construction and maintenance.	Federal construction and maintenance.
1889,	\$200,000	.....	.....
1890,
1900,
1901,
1902,	**\$3,940,000	.....	.....	**\$4,204,000
1903,	1,400,000
1904,	1,000,000
1905,	10,000	275,000	.....	500,000
1906,	***\$5,718,743	1,000,000
1907,	250,000	500,000	895,000
1908,	375,000
1909,	1,410,000	515,000
1910,	43,010	800,000
1911,	450,000	600,000	800,000
1912,	7,000	1,750,000
1913,	250,000	1,860,000	2,028,865
1914,	1,500,000	.....
	\$3,950,000	\$1,525,000	\$11,638,753	\$15,267,865

* Total expenditures up to December 31, 1902.

** From 1836 up to December 31, 1902.

*** Total between 1890 and July 1, 1907.

Federal:

Harbor, \$3,950,000 00
 River, 15,267,865 00

Total Federal, \$19,217,865 00

State, 1,525,000 00

City, 11,638,750 00

\$32,381,615 00

II. PRESENT CONDITIONS AND PROSPECTS OF THE PORT.

PORT BUSINESS.

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II. PRESENT CONDITIONS AND PROSPECTS OF THE PORT.

PORT BUSINESS.

1.—*Movement of Vessels, Tonnage and Values.*

The report of the United States Collector of the Port showed a decrease in value of foreign exports and imports and a corresponding shrinkage in the customs duties for the year 1913. The year 1912 recorded one of the largest movements in foreign trade in the port's history.

The following table compiled for The Public Service Commission, gives the comparative movement of vessels for three years:

ARRIVAL OF VESSELS DURING THE YEARS 1911, 1912 AND 1913 AT THE PORT OF PHILADELPHIA AS REPORTED BY THE COMMISSIONERS OF NAVIGATION.

Rig of Vessel.	1911		1912		1913	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
From Foreign Ports.						
Steamships,	1,233	4,558,621	1,259	4,892,052	1,275	4,907,684
Ships,	4	7,167	1	1,675	.....	.....
Barks,	24	26,859	17	26,063	15	23,551
Brigs,	2	840	.....	.....	.....	.....
Schooners,	68	32,352	50	28,265	43	21,964
Barges, .....	.....	.....	5	15,350	3	23,154
Totals,	1,331	4,625,839	1,332	4,963,435	1,336	4,976,353
From Coastwise Ports.						
Steamships,	1,789	3,068,982	1,529	2,781,517	1,473	2,795,608
Ships,	4	10,208	3	9,579	2	5,329
Barks,	7	13,391	12	15,643	10	11,582
Schooners,	623	512,133	476	376,519	458	492,124
Barges,	2,532	1,986,835	2,307	1,864,447	2,629	2,077,393
Totals,	4,955	5,591,549	4,327	5,047,705	4,572	5,382,036
Totals.						
Foreign vessels,	1,331	4,625,839	1,332	4,963,435	1,336	4,976,353
Coastwise vessels,	4,955	5,591,549	4,327	5,047,705	4,572	5,382,036
Totals,	6,286	10,217,388	5,659	10,011,140	5,908	10,358,389

According to the report of the United States Engineer Department, the total tonnage movement of foreign, coastwise and river vessels during the year 1911 amounted to 25,786,180 tons of merchandise, carrying a money value of \$1,209,-879,741; for 1912, the tonnage was 26,267,335 and the value \$1,235,106,621. For 1913, the tonnage was 26,445,058 and the value \$1,229,454,962. See table following:

AGGREGATE ANNUAL FREIGHT MOVEMENT ON THE DELAWARE RIVER FROM TRENTON, N. J., TO THE SEA.

(As reported by the United States Engineer Department.)

	1911		1912		1913	
	Quantity—Tons.	Value.	Quantity—Tons.	Value.	Quantity—Tons.	Value.
Foreign:						
Imports,	2,662,336	80,526,519	3,113,336	92,566,087	3,254,760	91,947,390
Exports,	2,945,686	70,869,648	2,852,436	72,769,617	2,685,004	72,236,967
Coastwise and domestic,	20,178,158	1,058,483,574	20,300,563	1,069,770,917	20,515,294	1,065,270,605
	(a)		(b)		(c)	
Totals,	25,786,180	1,209,879,741	26,267,335	1,235,106,621	26,455,058	1,229,454,962

(a)—Of this quantity about 4,984,635 tons were carried on car floats and lighters between Philadelphia and Camden.

(b)—Of this quantity about 4,685,234 tons were carried on car floats and lighters between Philadelphia and Camden.

(c)—Of this quantity about 4,535,130 tons were carried on car floats and lighters between Philadelphia and Camden.

Such an enormous business as this is worth taking care of. Director George W. Norris of the Department of Wharves, Docks, and Ferries, stated in his report for the year 1912 as follows:

“What the City of Philadelphia and the State of Pennsylvania have done in the past, and are doing at present, to encourage and improve this trade, however, could be told, unfortunately, in a few brief paragraphs.

“Without desiring to belittle in the slightest degree the earnest and long-continued efforts of the small band of public-spirited citizens who have worked consistently for many years for the advancement of the port, it can be said that the port's present business has, to a large extent, been forced upon it—in spite of itself, as it were—and represents comparatively little effort on the part of the City. What this business might have been with a tithe of the brain, spirit, and energy used in connection with it, which has been devoted to other lines of industrial up building in this city, is difficult to over-estimate.”

In this connection it may be well to look at the following table of annual value and tonnage of commerce on the Delaware River, compiled for The Public Service Commission. It will be noted that there has been but slight increase in value or tonnage during the last fifteen years.

ANNUAL VALUE AND TONNAGE OF COMMERCE, DELAWARE RIVER.

(Compiled from reports of The United States Engineer, Philadelphia Office.)

Calendar year.	Tonnage—Short tons.	Value.	Remarks.
1890,.....	12,250,000	\$295,000,000	Total tonnage and total value given include the entire river, bay and coastwise traffic as well as local movement of barges, lighters and car floats.
1891,.....	13,250,000	300,000,000	
1892,.....	14,400,000	300,000,000	
1893,.....	13,500,000	250,000,000	
1894,.....	13,350,000	350,000,000	
1895,.....	17,400,000	500,000,000	
1896,.....	15,300,000	565,000,000	
1897,.....	18,000,000	565,000,000	
1898,.....	18,400,000	750,000,000	
1899,.....	22,000,000	1,250,000,000	
1900,.....	24,000,000	1,550,000,000	
1901,.....	23,900,000	1,250,000,000	
1902,.....	22,000,000	1,650,000,000	
1903,.....	22,827,926	1,289,965,088	
1904,.....	23,372,036	1,579,060,906	
1905,.....	24,333,571	1,612,847,499	
1906,.....	26,111,047	1,472,540,364	
1907,.....	27,283,529	1,538,385,389	
1908,.....	24,023,895	1,249,175,518	
1909,.....	24,677,671	1,327,569,862	
1910,.....	25,496,213	1,340,391,894	
1911,.....	25,786,180	1,269,879,741	
1912,.....	26,267,335	1,235,106,621	
1913,.....	26,455,058	1,229,454,962	

2.—Freight Rates.

At present Philadelphia enjoys on its railroad freight traffic to interior points, slightly lower railroad rates than are given in New York.

FREIGHT CHARGES PER 100 LBS.

To Chicago From—	All Rail: Classes.						Lake and Rail: Classes.					
	1.	2.	3.	4.	5.	6.	1.	2.	3.	4.	5.	6.
	c	c	c	c	c	c	c	c	c	c	c	c
Boston,	70	61	47	33	28	23½	57	50	38	27	23	20
New York,	75	65	50	35	30	25	62	54	41	30	25	21
Philadelphia,	69	59	48	33	28	23	56	48	39	28	23	19
Baltimore,	67	57	47	32	27	22	54	46	38	27	22	18

Quoting further from Director Norris' report:

"The Port of Philadelphia is the natural and the economic outlet for oversea transportation of the products of Pennsylvania's multifarious industries. Inasmuch as industrial development is measured by the success with which trade can be maintained, it is self-evident truth that the State owes it to itself to give to these industries the most efficient and economic facilities for commerce in the Port."

3.—Economic Development of Pennsylvania.

a—Total Production.

The tonnage of the port is not increasing at a rate commensurate with the Economic Development of Pennsylvania.

The production of wealth in the State increased more rapidly during the decade ending 1910 than during any previous year.

TOTAL PRODUCTION OF WEALTH IN PENNSYLVANIA.

Year.	Value added by manufacture.	Value of products of mines and quarries.	Value of all farm products.	Total.
1860,	\$136,643,490	\$15,769,047	.....	\$152,412,537
1870,	290,696,671	76,208,390	\$183,946,027	550,851,088
1880,	279,797,882	67,503,784	129,760,476	477,062,142
1890,	558,060,264	150,876,649	121,328,348	830,265,261
1900,	792,356,261	236,871,417	207,895,600	1,237,123,278
1910,	1,044,182,000	346,960,603	265,037,191	1,655,179,794

b—Capital.

Between the years 1890 and 1910 the capital value of manufactures in Pennsylvania was practically doubled, due in part to very large increases in total values of products and in values added by manufacture.

The railroad mileage of Pennsylvania in 1911 was 11,340, equivalent to 25.3 miles for every 100 square miles of territory.

In the following table, the value for farms include land, buildings, implements, machinery, and live stock; manufacturing values include value of land, buildings, machinery, tools, implements, cash and sundries:

CAPITAL REPRESENTED BY FARMS, MANUFACTURING AND RAILROADS.

Year.	Farm properties.	Investments in manufacturing.	Commercial value of railroad operating property.
1890,	\$1,062,939,346	\$1,449,815,000	.....
1900,	1,051,629,173	1,995,837,000	\$1,420,608,000
1910,	1,253,274,862	2,749,006,000	.....

c—Cement Production.

Pennsylvania produces one-third of all Portland cement made in the United States. Most of it is made in the Lehigh Valley. This industry is so important to Pennsylvania that extension of the export trade in this commodity might well receive consideration. In 1913 the total quantity of hydraulic cement exported from the United States was only 2,964,358 barrels, valued at \$4,270,666.

CEMENT PRODUCTION IN PENNSYLVANIA.

Year.	Portland Cement.	
	Barrels.	Value.
1890,	221,000	\$439,050
1895,	504,276	756,414
1900,	4,984,417	4,984,417
1905,	13,813,487	11,195,940
1910,	26,675,978	19,551,268
1911,	26,864,679	19,258,253
1912,	26,441,338	18,918,165
1913,	28,701,845	24,268,800

d—Coal and Coke.

In the year 1912 the combined output of coal (hard and soft) was 246,227,086 short tons valued at \$346,993,123. In that year 86 per cent. of the anthracite and 72 per cent. of the bituminous coal was loaded at the mines for shipment; 2.8 per cent. of the anthracite and 2.4 per cent. of the bituminous coal was sold to local trade; and 10.6 per cent. and 2.2 per cent., respectively, was consumed for generating heat and power at the mines.

Twenty-three and four-tenths per cent. of the bituminous coal was made into coke.

PRODUCTION OF COKE IN PENNSYLVANIA.

Year.	Coke in short tons.	Value at Ovens.	
		Total.	Per ton.
1880,	2,821,384	\$2,255,040	\$1 86
1885,	3,991,805	4,981,656	1 25
1890,	8,560,245	16,333,674	1 91
1895,	9,404,215	11,908,162	1 26
1900,	13,798,893	29,692,258	2 22
1905,	20,573,736	42,253,178	2 05
1908,	15,511,634	32,569,621	2 10
1909,	24,905,525	50,377,035	2 02
1910,	26,315,607	55,254,599	2 10
1911,	21,923,935	48,053,867	1 96
1912,	27,438,693	56,267,838	2 05

Two counties in Pennsylvania—Fayette and Westmoreland—which include the Connellsville and Lower Connellsville Districts, produced (in 1912) 48 per cent. of the coke manufactured in the United States. The Connellsville territory is the greatest coke producing district in the world.

The total amount of anthracite coal in the ground is estimated at 15,000,000,000 tons. At the rate of 100,000,000 tons removed per year, this coal will last 150 years.

Less than \$3,000,000 worth of bituminous coal is exported each year from Philadelphia, although the value of this commodity produced in Pennsylvania in the year 1913 was \$193,000,000.

COAL PRODUCED IN PENNSYLVANIA.

Year.	Bituminous.		Anthracite.	
	Short tons.	Value.	Short tons.	Value.
1840,	464,825	.....	1,064,914	.....
1845,	700,000	.....	2,480,032	.....
1850,	1,000,000	.....	4,138,164	.....
1855,	1,780,000	.....	8,141,754	.....
1860,	2,690,786	\$2,876,579	8,115,842	\$11,869,574
1865,	6,350,000	.....	11,891,746	.....
1870,	7,798,518	13,921,069	15,664,275	38,436,745
1875,	11,760,000	.....	22,485,766	.....
1880,	18,425,163	18,567,129	28,711,379	42,282,948
1885,	26,000,000	24,700,000	33,335,973	76,671,948
1890,	42,302,173	35,376,916	46,468,641	66,383,772
1895,	50,217,223	35,980,357	57,999,337	82,019,272
1900,	79,842,326	77,438,545	57,367,915	85,757,851
1905,	118,413,637	113,390,507	77,659,850	141,875,000
1910,	150,521,526	153,029,510	84,485,236	160,275,302
1911,	144,561,237	146,154,952	90,464,067	175,189,392
1912,	161,865,488	169,370,497	84,361,598	177,622,626
1913,	173,781,217	193,039,806	91,524,922	195,181,127

4.—Commerce and Customs Duties.

The principal commodities of commerce carried on the Delaware River consist of the following:

Coal,
Lumber,
Ores,
Iron and steel products,
Petroleum and its by-products,
Sugar
Grain,
Food-stuffs,
General merchandise.

The situation as to port business, when studied, leads the thoughtful mind to inquire, why it should not be made to increase as the business in Pennsylvania may warrant. That the port business has not increased very much in the last decade is shown in the following three tabular statements. The first table gives the principal articles of commerce and their value as reported by the United States Custom House; the second gives the principal full cargoes brought to the port by the coastwise fleet; and the third table gives the customs duties for ten years past.

COMMERCE OF THE PORT OF PHILADELPHIA FOR THE YEARS 1911,
1912 AND 1913, AS REPORTED BY THE UNITED STATES CUSTOM
HOUSE.

Principal Articles and Value.	1911.	1912.	1913.
Exports.			
Bituminous coal,	\$2,197,725	\$2,378,299	\$2,603,915
Cotton,	3,938,085	4,037,894	3,295,637
Corn,	2,769,723	529,853	930,516
Cattle,	1,231,300	250,100	.....
Flour,	5,436,655	4,365,608	6,123,990
Glazed kid,	2,241,621	1,935,583	1,887,923
Illuminating oil,	14,127,603	14,099,765	13,890,288
Lubricating oil,	5,124,507	5,348,763	5,243,542
Lard,	3,407,391	3,020,064	1,574,235
Neutral lard,	817,793	1,643,925	600,510
Naptha, gasoline, etc.,	1,673,741	1,853,716	3,271,350
Oleo oil,	1,362,635	1,213,049	1,134,187
Paraffin and wax,	1,374,839	1,701,786	1,154,376
Pipe fittings,	1,230,431	1,210,852	841,334
Refined sugar,	128,180	1,259,822	103,376
Wheat,	3,214,007	5,146,135	6,836,325
All other articles,	20,588,412	22,770,008	22,742,163
Totals,	\$70,869,648	\$72,769,617	\$72,236,967
Imports.			
Bananas,	\$1,483,942	\$1,154,493	\$1,173,518
Burlaps,	1,831,405	2,776,595	3,532,801
Cocconut oil,	214,392	317,259	551,570
Goat skins,	7,396,322	8,182,075	8,993,999
Glycerine,	1,266,098	1,175,059	1,526,021
Iron ore,	3,039,994	4,072,772	4,809,961
Licorice root,	830,343	1,243,940	1,060,443
Manganese ore,	430,895	788,243	916,395
Palm oil,	930,646	1,017,571	1,001,370
Pig iron,	868,689	1,699,709	1,307,475
Soda, nitrate,	1,337,745	1,996,497	2,351,209
Sulphur ore,	548,448	483,453	482,052
Sugar,	9,665,405	11,791,213	9,027,602
Tin in bars,	821,874	720,779	1,030,134
Tobacco wrapper,	1,507,004	1,416,530	1,693,886
Tobacco leaf and other,	1,233,482	1,168,504	1,301,325
Wool, class 1,	629,460	1,795,727	1,149,712
Wool, class 2,	225,085	360,524	560,367
Wool, class 3,	2,726,408	3,766,677	2,797,457
All other articles,	43,880,730	46,638,466	46,680,093
Totals,	\$80,418,277	\$92,566,087	\$91,947,390

PRINCIPAL FULL CARGOES BROUGHT TO THE PORT OF PHILADELPHIA BY THE COASTWISE FLEET FOR THE YEARS 1911, 1912 AND 1913.

(Does not include cargoes of regular line steamships.)

Articles of Import.	1911.	1912.	1913.
Cinders,	34,284 tons	49,875 tons	53,618 tons
Lumber,	219,884,525 ft.	186,027,191 ft.	212,107,867 ft.
Mine props,	86,926 tons	58,242 tons	99,655 tons
Oil,	3,317,787 bbls.	2,758,434 bbls.	3,582,733 bbls.
Piling, .....	.....	11,290 tons	4,300 tons
Pig iron,	42,294 tons	37,438 tons	46,019 tons
Pulp wood,	42,860 tons	30,651 cords	30,468 cords
Phosphate rock,	60,738 tons	41,056 tons	47,003 tons
Ties,	1,397,425	566,383	1,269,702
Shingles,	4,000,000	2,400,000	1,108,000
Stone,	32,165 tons	19,605 tons	20,896 tons
Sand,	14,695 tons	11,133 tons	9,390 tons
Coal tar products,	44,225 bbls.	66,701 bbls.	110,750 tons
Sulphur, .....	.....	12,300 tons	3,900 tons
Tankage, .....	.....	2,456 tons	2,594 tons

CUSTOMS' DUTIES, PORT OF PHILADELPHIA.

Comparative Statement of Quantity and Value of Exports, Imports, and Revenue Collected as Reported by United States Engineer Departments.

Years.	Exports.		Imports.		Revenue collected.
	Quantity—Tons.	Value.	Quantity—Tons.	Value.	
1903,	2,378,307	\$73,184,394	1,561,052	\$55,516,052	\$21,020,331
1904,	2,552,065	66,539,909	1,057,348	53,852,194	17,997,700
1905,	3,267,439	70,645,103	1,365,245	67,913,822	20,022,804
1906,	3,800,995	88,276,315	1,732,935	72,137,678	20,505,545
1907,	4,056,716	106,570,527	1,800,520	80,693,327	21,044,274
1908,	3,532,472	95,533,079	1,551,015	57,407,935	16,963,929
1909,	3,041,433	80,503,231	2,234,039	78,001,864	20,810,442
1910,	2,532,677	65,256,949	2,948,179	89,646,337	21,888,825
1911,	2,945,686	70,869,648	2,622,336	80,418,277	19,571,889
1912,	2,853,436	72,769,617	3,113,336	92,566,087	21,494,085
1913,	2,799,298	72,236,967	3,254,760	91,947,390	19,356,120

5.—Steamship Lines

There are 17 trans-Atlantic lines of steamships doing freight or passenger business, or both, between Philadelphia and more than a dozen European ports. During 1913, these lines had 340 sailings, never before equaled in regular-line sailings from Philadelphia. Two tables are given showing the steamship lines, where they dock and the service engaged in for foreign, coastwise, local and inland lines.

STEAMSHIP LINES—PORT OF PHILADELPHIA—WHERE THEY DOCK AND SERVICE.

LOCAL AND INLAND LINES.

Line.	Pier No.	Location.	Service Between Philadelphia and	Sailings.
Augustine Park Steamboat Co.,	4 North,	Arch Street,	Chester, Pennsgrove, New Castle, Port Penn,	Daily.
Bush Line,	10 North,	Race Street,	Marcus Hook, Wilmington, New Castle,	Daily.
Chester Shipping Co.,	4 North,	Arch Street,	Chester and Intermediate Points,	Daily.
Delaware River Trans. Co.,	5 South,	Chestnut Street,	Burlington, Bristol and Intermediate Points,	Daily.
Dover & Phila. Nav. Co.,	5 North,	Arch Street,	Bowers, Beach, Lebanon and Dover,	Daily.
Ericson Line,	3 South,	Chestnut Street,	Chester, Delaware City and Baltimore,	Daily.
Frederica & Phila. Nav. Co.,	3 South,	Chestnut Street,	Bowers Beach and Frederica,	Daily.
Great Northern Paper Co.,	19 North,	Vine Street,	Stockton Springs, Maine,	Monthly.
Millford & Phila. Trans. Co.,	3 South,	Chestnut Street,	Millford and Intermediate Points,	Daily.
Odessa Steamboat Co.,	4 North,	Arch Street,	Port Mott, Port Penn, Middleton and Odessa,	Daily.
Phila., Rancocas & Mt. Holly Transportation Co.,	4 North,	Arch Street,	Rancocas, Mt. Holly and Intermediate Points,	Daily.
Salem Freight Co.,	4 North,	Between Arch and Race,	Billingsport, Pennsgrove, Pennsville and Salem,	Daily.
Smyrna Steamboat Co.,	4 North,	Arch Street,	Smyrna and Intermediate Points,	Daily.
Trenton Steamboat Co.,	10 North,	Race Street,	Trenton,	Daily.
Wilmington Steamboat Co.,	5 South,	Chestnut Street,	Chester and Wilmington,	Daily.

STEAMSHIP LINES ENTERING THE PORT OF PHILADELPHIA, WHERE THEY DOCK, AND OUT AND INBOUND SERVICE

TRANS-ATLANTIC AND COASTWISE.

Line.	Pier No.	Location.	Outbound Service to	Inbound Service from	Sailings.
American-Indian Line,	34-36 South,	Kendalworth & Christian Sts., .....	.....	Bombay, Calcutta,	Monthly.
American-Hawaiian,	60-61 South,	Dickinson Street, .....	.....	Hawaiian Islands & Pacific Coast Ports via Panama Canal,	Monthly.
Atlantic-Transport Line,	46-48-55 South ..	Christian St. & Wash. Ave. below Federal, .....	.....	London,	Semi-monthly.
Allan Line,	24 North,	Callowhill Street,	Glasgow,	Glasgow, Liverpool, St. Johns, N. F., Halifax,	Semi-monthly.
American Line,	53 South,	Washington Ave.,	Liverpool, Queenstown,	Liverpool, Queenstown,	Weekly.
American-Levant Line,	34 South,	Kenilworth Street,	Smyrna, Alexandria,	Smyrna, Alexandria,	Monthly.
Austro-American Line,	16 South,	Dock Street,	Trieste, Fiume,	Trieste, Fiume,	Semi-monthly.
Atlantic Fruit Co.,	3 South,	Above Chestnut St.,	Jamaica and others,	Jamaica and others,	Weekly.
Bombay-American Line,	Girard Point,	Schuykill River, .....	.....	Bombay,	Monthly.
Cosmopolitan Line,	A-B-C-D, 27 North,	Above W. Main Street below Noble Street,	Leith, Christiana Copenhagen, Stettin,	Leith, Christiana Copenhagen, Stettin,	Weekly.
Clay Line,	27 North,	Girard Schuykill Point, .....	.....	Fowey,	Semi-monthly.
Cunco Importing Co.,	10 North,	Race Street,	Jamaica,	Jamaica,	Weekly.
Clyde Line,	1-2-3 North,	Above Market Street,	Norfolk, Newport News and New York,	Norfolk, Newport News & New York,	Daily.
Earn Line, .....	.....5,	Girard Pt.-Port Richmond, Greenwich Pt.,	West Indies,	West Indies,	Tramp.
Furness Line,	28 North,	Port Richmond,	Leith, Middlesboro,	Leith, Middlesboro,	Semi-monthly.
Hamburg-American Line,	46-48 South,	Washington Avenue,	Hamburg,	Hamburg,	Bi-monthly.
Hansa Line,	46 South,	Christian Street,	Calcutta,	Calcutta,	Monthly.
Holland-American Line,	48 South,	Washington Avenue,	Rotterdam,	Rotterdam,	Every 3 weeks.
Italian Line,	19 North,	Above Vine Street,	Naples, Genoa,	Naples, Genoa,	Every 3 weeks.
Lloyd-Sabaudo Line,	19 North,	Above Vine Street,	Naples, Genoa,	Naples, Genoa,	Monthly.
Manchester Line,	"D",	Port Richmond,	Manchester,	Manchester, St. Johns, N. H.,	Bi-monthly.

Merchants & Miners Trans. Co., ..	18-24 South,	Spruce to Lombard Sts.,	Jacksonville, Savannah, Pro- vidence, Fall River, Bos- ton.	Jacksonville, Savannah, Pro- vidence, Fall River, Bos- ton.	Semi-weekly.
Munson Line, .....	.....	Port Richmond, Greenwich Pt.	Irregular service,	Irregular service,	Tramp.
North German Lloyd,	34 South,	Fitzwater Street,	Bremen,	Bremen,	Semi-monthly.
Phila. Trans-Atlantic Line, ..	25 North,	Pier A.,	London,	London,	Bi-weekly.
Phila.-New Orleans Trans. Co., ..	19 North,	Vine Street,	New Orleans, Charleston, ..	New Orleans, Charleston, ..	Bi-weekly.
Red Star Line,	53 South,	Reed Street,	Antwerp, Dover, ..	Antwerp,	Monthly.
Scandinavian-American,	27 North,	Noble Street,	Christiana, Copenhagen, ..	Christiana, Copenhagen, ..	Occasionally.
Sota & Aznar,	Grand Point,	Schuykill River,	Tampa, Key West, Jackson- ville, Charleston, ..	Tampa, Key West, Jackson- ville, Charleston, ..	Bi-weekly.
Southern Steamship Co.,	46 South,	Christian Street,	Jamaica and West India Ports.	Jamaica and West India Ports.	Bi-weekly.
United Fruit Co.,	5 North,	Arch Street,			

OIL LINES.

Atlantic Refining Co.,	Point Breeze,	Schuykill River,	English and other European ports,	Sabine, Port Arthur, Texas,	Bi-weekly.
Gulf Refining Co.,	Gibsons Point, ..	Schuykill River, ..	New York,	Port Arthur, Texas,	Bi-weekly.
Pure Oil Co.,	Marcus Hook, ...	Delaware River, ..	English and other European ports,	Sabine, Texas,	Bi-weekly.
Sun Company,	Marcus Hook, ...	Delaware River, ..		Port Arthur, Texas,	Bi-weekly.
Texas Company,	Marcus Hook, ...	Delaware River, ..			

PORT FACILITIES.

1.—*Ownership of Water Front.*

Director Norris has said, "The modern port is a complicated piece of machinery, and it cannot be successfully planned or administered without full legislative authority. Private ownership and control of water front facilities in great cities is rapidly becoming obsolete. It is now universally recognized that municipal ownership and control is essential to the proper development of any port. This is particularly true of Philadelphia. Large stretches of available water front on the Delaware River are owned but not used or occupied by transportation companies. The City's ownership amounts to only about ten per cent. (10%). The balance is in private ownership, but is generally split up into very small parcels, and is either wholly undeveloped or only partially developed by the construction of small piers of an obsolete type, and usually with very inadequate docking facilities. It is not generally practicable for these owners to combine adjoining parcels of land, while any attempt by the city to purchase several adjoining pieces is usually blocked by the excessive price demanded by some particular owner who realizes that his holding is essential to the development of a large plan. Even where these individual holdings are capable of development, the owners can hardly be expected to invest additional capital needed for the improvement in competition with municipal piers. It is, therefore, as much to the interest of the individual owner who is willing to sell at a fair price, as it is to the interest of the entire community, that the city should be vested with a general power of eminent domain for the acquisition of wharf property.

This explains why the Legislature of 1913 amended the law so that it is now possible to acquire any water front property needed for any legitimate purpose in connection with the development of the Port. The State may aid. All of which shows that a small beginning only has been made towards the creation of a maritime center at Philadelphia that will be second only to New York in the United States, and one of the important ports in the world.

2.—*Wharves, Docks and Ferries.*

The accompanying table, entitled—Occupation of the Navigable Water Fronts Along the Delaware and Schuylkill Rivers in the City of Philadelphia, as of the year 1913, sub-divided into north and south wharves, Delaware River, and east and west wharves, Schuylkill River, compiled by the Bureau of Engineering, Public Service Commission, gives the location of each property and the owner, description and dimensions, with the leases in force and remarks.

OCCUPATION OF THE NAVIGABLE WATER FRONT ALONG THE DELAWARE AND SCHUYLKILL RIVERS IN THE CITY
OF PHILADELPHIA AS OF THE YEAR 1913.
COMPILED BY THE BUREAU OF ENGINEERING, PUBLIC SERVICE COMMISSION.

DELAWARE RIVER—NORTH WHARVES.

Location of Property.	Owner.		Description.		Leases in Force.		Remarks.
	Private.	Public.	General.	Dimensions. Lin.Ft. Sq. Ft.			
Pier No. 1—North of Market St.,	Girard Estate, ...	.....	.....	.....	Clyde Steamship Co. of Maine.	.....
Pier No. 2—North of Market St.,	Girard Estate, ...	.....	.....	.....	Clyde Steamship Co. of Maine.	.....
Pier No. 3—North of Market St.,	Thomas Clyde Est.,	.....	.....	.....	Clyde Steamship Co. of Maine.	.....
Bulkhead—S. of Pier No. 4,....	.....	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	72	Clyde Steamship Co. of Maine.	.....
Pier No. 4—Arch St., .....	.....	City of Phila.,	Open pile substructure with one story steel frame super- structure.	80x530	Chester Shipping Co. Phila. Rancocas Mt. Holly Co.	42,445	
Bulkhead behind pier, .....	.....	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	.....	Woodland Steamboat Co. Odessa Steamboat Co. Smyrna Steamboat Co. Washington Park Amuse- ment Co.	.....
Bulkhead—N. of Pier No. 4, ..	.....	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	40	Keystone Telephone Co. Columbia Transportation Co.	.....	Docking privilege.

DELAWARE RIVER—NORTH WHARVES—Continued.

Location of Property.	Owner.		Description.			Leases in Force.	Remarks.
	Private.	Public.	General.	Dimensions.			
				Lin.Ft.	Sq. Ft.		
Pier No. 5,	United Fruit Co. of Boston.	.....	.....	.....	.....	Lebanon Navigation Co.	
Pier No. 8,	Delight Valley Railroad Co.	.....	.....	.....	.....	Sun Oil Co.	
Bulkhead—S. of Pier No. 10,	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	90			
Pier No. 10—Race St.,	City of Phila.,	Open pile substructure, two story steel frame superstructure.	80x539	43,120	Trenton Transportation Co. Cunco Importing Co.	$\frac{1}{2}$ mi. from Market St.
Bulkhead behind Pier No. 10,	City of Phila.,	Concrete, deep wall, pile and riprap foundation.				
Bulkhead N. of Pier No. 10,	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	15	.....	Baltimore and Ohio R. Co.	
Bulkhead—S. of Pier No. 11,	City of Phila.,	Concrete, deep wall, pile and riprap foundation.			Baltimore and Ohio R. Co.	
Pier No. 11,	City of Phila.,	Open pile substructure, one story timber superstructure.	50x540	31,860		
Bulkhead behind Pier No. 11,	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	59	.....	Baltimore and Ohio R. Co.	
Bulkhead shed N. Pier No. 11,	City of Phila.,	Open pile substructure, one story timber superstructure.	63x60	3,780	Baltimore and Ohio R. Co.	
Bulkhead behind shed,	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	63	.....	Baltimore and Ohio R. Co.	

Pier No. 12,	Penn. Co. for Insurance on Lives and granting Annuities.	.....	Concrete, deep wall, pile and riprap foundation.	.....	Baltimore and Ohio R. R. Co.	.....
Summer St.—Bulkhead, .....	.....	.....	.....	15	.....	.....
Pier No. 13,	Penna. R. R. Co.,	City of Phila.,	.....	.....	.....	.....
Pier No. 14,	Penna. R. R. Co.,	.....	.....	.....	.....	.....
Pier No. 15,	Penna. R. R. Co.,	.....	.....	.....	.....	.....
Vine St. Ferry Slip, .....	.....	City of Phila.,	Open pile substructure, one story, corrugated superstructure.	107	Cooper Point and Phila. Ferry Co.	.....
Bulkhead behind Ferry Slip, ..	.....	City of Phila.,	Concrete wall on timber platform and piles.	107	.....	.....
Bulkhead N. of Ferry Slip, ....	.....	City of Phila.,	Concrete wall on timber platform and piles.	223	.....	.....
Pier No. 19—Vine St., .....	.....	City of Phila.,	Concrete cross wall on piles, substructure, with two story steel frame superstructure.	166x562	Phila. and New Orleans Transportation Co. Italia Line.	1/2 mi. from Market St.
Bulkhead behind Pier No. 19, ..	.....	City of Phila.,	Concrete wall on timber platform and piles.	166	A. S. Palmer.	.....
Bulkhead—S. of Callowhill St.,	.....	City of Phila.,	Concrete wall on timber platform and piles.	104	Great Northern Paper Co.	.....
Callowhill St. Bulkhead, .....	.....	.....	.....	.....	.....	.....
Pier No. 24,	Phila. & Read. R. R.	City of Phila.,	.....	50	Allen Steamship Line.	.....
Pier No. 26,	Phila. & Read. R. R.	.....	.....	.....	Phila. Trans-Atlantic Line.	.....
Pier No. 28,	Phila. & Read. R. R.	.....	.....	.....	Phil. Line.	.....
Pier No. 29,	Phila. & Read. R. R.	.....	.....	.....	Holland-American Line.	.....
Pier No. 30,	Phila. & Read. R. R.	.....	.....	.....	.....	.....
Pier No. 31,	Geo. H. Kidd.	City of Phila.,	Solid crib, .....	.....	Alex. Kerr Bros.	.....
Bulkhead—S. Pier No. 32, ....	.....	City of Phila.,	Solid crib substructure, no superstructure.	14	Geo. W. Kugler & Son.	.....
Pier No. 32—Green St., .....	.....	City of Phila.,	Solid crib substructure, no superstructure.	51x520	Geo. W. Kugler & Son.	.....
Lot behind Pier No. 32, .....	.....	City of Phila.,	13-story brick office and store house and timber shed.	64x77 64x160	Geo. W. Kugler & Son.	.....
N. W. Corner Delaware Ave. and Green St.	.....	City of Phila.,	.....	.....	Geo. W. Kugler & Son.	.....
Pier No. 33,	Phila. Rapid Transit Co.	.....	.....	.....	.....	1/2 mi. from Market St.

DELAWARE RIVER—NORTH WHARVES—Continued.

Location of Property.	Owner.		Description.	Dimensions.		Leases in Force.	Remarks.
	Private.	Public.		L.n.Ft.	Sq. Ft.		
Pier No. 34,	Phila. Rapid Transit Co.	City of Phila.,	Concrete wall on timber platform and piles.	38			
Bulkhead S. of Fairmount Ave.,		City of Phila.,	Solid crib substructure except on south side from off-set in which crib is on piles; no superstructure.	Irregular shape	23,900	Cornworth Bell Co.	
Pier No. 35—Fairmount Ave.,		City of Phila.,	1½ story brick building for storage 15x30, timber storehouse and shed 20x38, stable 56x60, timber shed with corrugated iron roof 20x38.	60x150	9,076	Samuel Hamilton.	
S. W. Corner Delaware and Fairmount Avenues,		City of Phila.,	Concrete wall on timber platform and piles.	22			
Bulkhead N. of Pier No. 35, ..		City of Phila.,	Wood frame,	21x32	682	Department of Wharves, Locks and Ferries, American Ice Co.	
Department Shop,	Thos. H. Powers Estate.	.....	.....	.....	.....
Pier No. 35½,	Thos. H. Powers Estate.	.....	.....	.....	.....
Canal St.—Bulkhead,	Thos. H. Powers Estate.	City of Phila.,	Crib on piles,	40		Chas. F. Felin Co.	
Pier No. 36, .....	.....	City of Phila.,	.....	.....	.....
Poplar St.—Bulkhead, .....	.....	City of Phila.,	Solid crib,	50		Edwin F. Henson.	
Lot behind Poplar St. Bulkhead,	Edwin Henson & Clayton Nichols.	City of Phila.,	.....	50x200	10,000		
Pier No. 37,	Edwin Henson & Clayton Nichols.	.....	.....	.....	.....
Pier No. 38,	Edwin Henson & Clayton Nichols.	.....	.....	.....	.....

Pier No. 39,	Clayton Nichols,...	.....	.....	.....	Baltimore and Ohio R. R. Co.
Pier No. 40,	Terminal Land Co.,	.....	.....	.....	Phila. Rapid Transit Co.
Pier No. 41,	Electric Traction Co.	.....	.....	.....	Chas. F. Felin Co.
Pier No. 42,	W. S. Taylor & C. M. Peters,	.....	.....	.....
Pier No. 43,	Phila. & Read. R. R.	.....	.....	.....
Laurel St.—Bulkhead, .....	.....	.....	.....	.....
Lot behind bulkhead, .....	.....	.....	.....	.....
Pier No. 44,	Ed. B. Malone Co.	.....	50	9,533	Watson, Malone & Sons,
Pier No. 45,	J. W. Paxson Co.	.....	50x100	.....	Watson, Malone & Sons,
Pier No. 46,	Penna. Sugar Co.	.....	.....	.....
Pier No. 47,	Geo. W. Gormley,	.....	.....	.....
Pier No. 48,	Penna. R. R. Co.,	.....	61	.....	Kensington & N. J. Ferry Co.
Shackamaxon St.—Ferry Slip, ..	.....	.....	6	.....	Kensington & N. J. Ferry Co.
Bulkhead behind Ferry Slip, ..	.....	.....	.....	.....
Pier No. 49,	Penna. R. R. Co.,	.....	.....	.....
Pier No. 50,	Penna. R. R. Co.,	.....	.....	.....
Pier No. 51,	A. B. Vrooman & Co.	.....	.....	.....
Pier No. 52,	J. W. Janney,	.....	.....	.....	Frank Merrihew and Sons Co.
Pier No. 53,	Frank Merrihew,	.....	.....	.....
Marlborough St.—Bulkhead, .....	.....	.....	47	.....
Lot behind Bulkhead, .....	.....	.....	47x202	9,595	T. B. Hommer, General Chemical Co. of Camden.
Pier No. 54,	American Sheet and Tin Plate Co.	.....	.....	.....	American Ice Co.
Pier No. 55,	Knickerbocker Ice Co.	.....	.....	.....	Chas. Lennig & Co.,
Pier No. 56,	Chas. Lennig, .....	.....	.....	.....
East Columbia Ave. Bulkhead, ..	.....	.....	50	.....
Bulkhead N. of E. Columbia Ave.,	.....	.....	52	.....
Pier No. 57—E. Columbia Ave. (Penn Treaty Park.)	.....	.....	153x152	24,016	
Landing platform for boats in front of Pier No. 57,	.....	.....	.....	.....
Pier No. 59, .....	.....	.....	.....	.....
Pier No. 60,	Phila. Elec. Co.,...	.....	.....	.....
Pier No. 61,	Phila. Elec. Co.,...	.....	.....	.....
Pier No. 61½,	Porter-Gildersleeve Co.	.....	64x8	490	
Palmer St.—Bulkhead, .....	.....	.....	.....	.....
	.....	.....	30x220	8,580	Porter-Gildersleeve Co.
	.....	.....	.....	.....	Concrete wall on crib foundation sub-structure.

1 mi. from Market St.

13 mi. from Market St.

DELAWARE RIVER—NORTH WHARVES—Continued.

Location of Property.	Owner.		Description.		Leases in Force.	Remarks.
	Private.	Public.	General.	Dimensions.		
				Lin.Ft. Sq. Ft.		
Lot behind Bulkhead,		City of Phila.,	Timber trestle run- way and dump platform substructure.	45x232 10,482	Kensington Ship Yard Co.,....	13 mi. from Market St.
Pier No. 62,	Wm. Cramp & Sons Ship and Engine Bldg. Co.	.....	.....	.....	Kensington Ship Yard Co.	
Pier No. 62½,	Wm. Cramp & Sons Ship and Engine Bldg. Co.	.....	.....	.....	Kensington Ship Yard Co.	
Pier No. 63,	Wm. Cramp & Sons Ship and Engine Bldg. Co.	.....	.....	.....	Kensington Ship Yard Co.	
Pier No. 63½,	Wm. Cramp & Sons Ship and Engine Bldg. Co.	.....	.....	.....	Kensington Ship Yard Co.	
Pier No. 65,	Wm. Cramp & Sons Ship and Engine Bldg. Co.	.....	.....	.....	Kensington Ship Yard Co.	
Pier No. 66,	Wm. Cramp & Sons Ship and Engine Bldg. Co.	.....	.....	.....	Kensington Ship Yard Co.	
Pier No. 67,	Hughes & Patter- son.	.....	.....	.....	Kensington Ship Yard Co.	
Berks St. Bulkhead,	DeFrain Sand Co.,	City of Phila.,	Concrete wall on timber platform and piles.	30 30x332	DeFrain Sand Co.	
Lot behind Bulkhead,	Wm. M. Lloyd Co.,	.....	.....	.....
Pier No. 68,	Wm. M. Lloyd Co.,	.....	.....	.....
Pier No. 69,	Wm. M. Lloyd Co.,	.....	.....	.....
Bulkhead S. of Pier No. 70, ..	.....	City of Phila.,	Solid crib,	28 77x260		
Lot behind Pier No. 70, .....	.....	City of Phila.,	Storage yard of City Water Bureau.	.....	
Pier No. 70—E. Susquehanna Ave. ....	.....	City of Phila.,	Solid crib substructure, one story covered with gal- vanized iron, re- creation pavilion 24x47.	50x265 13,117		

Pier No. 71,	Hughes & Patter- son, .....	.....	.....	.....	.....	Seaman and Mannough.	
Pier No. 72,	Hughes & Patter- son, .....	.....	.....	.....	.....	Hainesport Mining and Transportation Co.	
Dyott St.—Bulkhead, .....	.....	.....	.....	.....	100	.....
Pier No. 75,	Lehigh Coal and Navigation Co. ....	.....	Concrete wall on timber platform and piles—outlet for sewer 8½'x14'. ..	.....	.....	Bernard and Samsel Towing Line.	13 mi. from Market St.
Pier No. 76,	Lehigh Coal and Navigation Co. ....	.....	.....	.....	.....	Bernard and Samsel Towing Line.	
Pier No. 77,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 78,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 79,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 80,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 81,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 82,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 83,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 85,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....	2 mi. from Market St.
Pier No. 86,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 20 (beginning 3d series),	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 18,	Wm. Cramp & Sons Ship and Engine Building Co. ....	.....	.....	.....	.....	.....
Pier No. 16,	Phila. & Read. R. R. ....	.....	.....	.....	.....	.....
Pier No. 15,	Phila. & Read. R. R. ....	.....	.....	.....	.....	.....
Pier No. 14,	Phila. & Read. R. R. ....	.....	.....	.....	.....	.....
Pier No. 13,	Phila. & Read. R. R. ....	.....	.....	.....	.....	.....

DELAWARE RIVER—NORTH WHARVES—Continued.

Location of Property.	Owner.		Description.		Leases in Force.	Remarks.
	Private.	Public.	General.	Dimensions. Lin.Ft. Sq.Ft.		
Pier No. 12,	Phila. & Read. R. R.	.....	.....	.....	.....	2½ mi. from Market St.
Pier No. 11,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier No. 10,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier No. 9,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier No. 8,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier No. 7,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier No. 6,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier No. 5,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier No. 4,	Phila. & Read. R. R.	.....	.....	.....	.....	2½ mi. from Market St.
Pier No. 3,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier No. 2,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier No. 1,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier A,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier B,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier C,	Phila. & Read. R. R.	.....	.....	.....	.....	2½ mi. from Market St.
Pier D,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier E,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier F,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier G,	Phila. & Read. R. R.	.....	.....	.....	.....
Pier H,	Phila. & Read. R. R.	.....	.....	.....	.....	3 mi. from Market St.

Pier J,	Phila. & Read, R. R.	City of Phila.,	Outlet from sewer,	28 57x51 1	29,127	United Gas Improvement Co., 3 1/2 mi. from Market St.
Bulkhead S. of Pier No. 126, .....	.....	City of Phila.,	Solid crib substructure and one story timber recreation pavilion 42x36.	35 64	.....	United Gas Improvement Co.
Pier No. 126 Allegheny Ave., ....	.....	.....	Dry rubble wall,	5 75x56 0	41,250	United Gas Improvement Co.
Bank unprotected, Tioga St. bank, .....	.....	City of Phila.,	structure, no super- structure.	80 irregu- lar	25,385	United Gas Improvement Co.
Bank N. of Tioga St., .....	.....	City of Phila.,	Part solid crib, part pile substructure,	145 15	.....	United Gas Improvement Co.
First pier N. of Tioga St., ....	.....	City of Phila.,	no superstructure, Solid crib, .....	.....	.....	United Gas Improvement Co.
Bulkhead N. of first pier, .....	.....	City of Phila.,	Dry rubble wall, ....	.....	.....	Pierson & Ladasher Lum- ber Co.
Second pier N. of Tioga St., ...	.....	City of Phila.,	.....	.....	.....	Pierson & Ladasher Lum- ber Co.
Bulkhead N. of Pier, .....	.....	City of Phila.,	Dry rubble wall,	64	.....	.....
Bank N. of Bulkhead, .....	.....	City of Phila.,	.....	.....	.....	.....
Pier near Westmoreland St., ...	Ontario Land Co.,	.....	.....	.....	.....	.....
Pier near Westmoreland St., ...	Ontario Land Co.,	.....	.....	.....	.....	.....
Venango St. Bank,	M. L. Shoemaker and Co.	City of Phila.,	Dry rubble wall,	40x80	3,200	.....
Pier-N. of Venango St., .....	.....	City of Phila.,	Solid crib substructure, double deck recreation pavilion 51x24 superstructure.	60 60	.....	.....
Bridge St.-Pier, .....	.....	City of Phila.,	Dry rubble wall, ....	.....	.....	.....
Orthodox St. Bank, .....	.....	City of Phila.,	Concrete wall on crib	17	.....	.....
Robbins St.-Bulkhead, .....	.....	City of Phila.,	Concrete wall on crib	50x92	4,600	Lardner Point Pumping Station. Lardner Point Pumping Station.
Bulkhead-N. of Robbins St., ..	.....	City of Phila.,	Solid crib substructure, no super- structure.	199	.....	Lardner Point Pumping Station.
1st Pier-N. of Robbins St., ..	.....	City of Phila.,	Solid crib,	125	.....	Lardner Point Pumping Station.
Bulkhead-N. of first pier, ..	.....	City of Phila.,	dry rubble wall,	125	.....	Lardner Point Pumping Station.
Bulkhead-N. of first pier, ..	.....	City of Phila.,	Unprotected,	33x180	6,940	Lardner Point Pumping Station.
Bank N. of first pier, .....	.....	City of Phila.,	Concrete wall on timber platform and piles; sub- structure; no sup- erstructure.	.....	.....	.....
2d Pier N. of Robbins St., ....	.....	City of Phila.,	.....	.....	.....	.....

DELAWARE RIVER—NORTH WHARVES—Continued.

Location of Property.	Owner.		Description.			Leases in Force.	Remarks.
	Private.	Public.		Lin.Ft.	Sq.Ft.		
Lewick St.—Bulkhead,	City of Phila.,	Concrete face wall,...	60	.....	Lardner Point Pumping Station.	7 mi. from Market St.
Pier—House of Correction,	City of Phila.,	Solid crib substructure, two story timber store house belonging to Dept. of Wharves, Docks and Ferries.	54x450	22,500	House of Correction,	8½ mi. from Market St.
Pennypack Creek Bulkhead from Hook Creek.	City of Phila.,	Dry rubble wall,	3,200	.....	House of Correction.	
Bank—Torresdale Creek to Torresdale Coal Pier.	City of Phila.,	Unprotected,	1,186	.....	Torresdale Filter Plant,	9½ mi. from Market St.
Pier—Torresdale Coal Pier,	City of Phila.,	Open pile substructure, no superstructure.	33x330	11,700	Torresdale Filter Plant.	
Bank N. of coal Pier,	City of Phila.,	Unprotected,	500	.....	Torresdale Filter Plant.	
Pennypack St.—Pier,	City of Phila.,	Open pile substructure, no superstructure.	60x100	6,000	Torresdale Filter Plant.	
Bank—to Linden St.,	City of Phila.,	Unprotected,	3,403	.....	Torresdale Filter Plant,	10½ mi. from Market St.
Bank—Linden to Arendell St.,	City of Phila.,	Dry rubble wall,	601	.....	Pleasant Hill Park.	
Lot behind Bank,	City of Phila.,	Unprotected,	601x190	114,190	Pleasant Hill Park.	
Bank—Arendell St. to Fishers Landing,	City of Phila.,	Dry rubble wall,	170	.....	Pleasant Hill Park,	10½ mi. from Market St.
Lot behind Bank,	City of Phila.,	.....	170x190	32,300	Pleasant Hill Park.	

DELAWARE RIVER—SOUTH WHARVES

Location of Property.	Owner.		Description.	Dimensions.		Leases in Force.	Remarks.	
	Private.	Public.		General.	Dimensions.			
					Lin.Ft.			Sq.Ft.
Ferry Slip—N. of Market St., .. Market St.—Ferry Slip,	Penna. R. R. Co.	City of Phila.,	Timber piles and short steel columns substructure, two story steel and timber frame with metal covering superstructure.	100	.....	Camden and Philadelphia Steamboat Co. West Jersey Ferry Co.	
Bulkhead behind Slip, Ferry Slip S. of Market St., ....	..... Penna. R. R. Co.	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	100	.....	Porter, Gildersleeve Co.	
Pier No. 1, Blackhorse Alley—Bulkhead,	Wm. J. Thompson, Penna. R. R. Co.	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	10	.....	Atlantic Fruit Co. U. S. Government. Frederica, Phila. Navigation Co.	
Pier No. 3,	Phila. & Baltimore Steamship Co. .....	.....	.....	.....	.....	Milford Navigation Co. Ericson Line.	
Bulkhead N. of Pier No. 5, ..	.....	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	74	.....	Delaware River Transportation Co. Wilmington Steamboat Co. Phila. & Reading R. R. Co.	
Pier No. 5—Chestnut St., .....	.....	City of Phila.,	Open pile substructure, two story steel frame metal covered superstructure, recreation pavilion on upper deck.	80x553	44,250		
Bulkhead behind Pier No. 5, ..	.....	City of Phila.,	Concrete, deep wall, pile and riprap foundation.	80	.....		

DELAWARE RIVER—SOUTH WHARVES—Continued.

Location of Property.	Owner.		Description.	Dimensions.		Leases in Force.	Remarks.
	Private.	Public.		Gen- eral.	Lin.Ft. Sq.Ft.		
Pier No. 8,	Phila. & Read. R. R. Co.	.....	.....	.....	.....	.....	.....
Pier No. 9,	E. T. Warner & A. D. Warner.	.....	.....	.....	.....	.....	.....
Walnut St.—Bulkhead, .....	.....	City of Phila.,	Concrete, deep wall, pile and foundation.	.....	50	Geo. W. Bush & Sons Co. Penna. R. R. Co.	.....
Pier No. 10,	Penna. R. R. Co., .....	.....	.....	.....	.....	.....	.....
Pier No. 11,	Penna. R. R. Co.	City of Phila.,	Concrete wall on timber platform.	.....	109	.....	.....
Pier No. 14,	Penna. R. R. Co.	City of Phila.,	Concrete wall on timber platform.	.....	14	.....	.....
Dock St.—Bulkhead, .....	.....	City of Phila.,	Concrete and pile substructure, steel superstructure with reinforced concrete ends.	.....	120x52	.....	.....
Bulkhead S. of Dock St., .....	.....	.....	.....	.....	69,840	.....	.....
Pier No. 16, .....	.....	City of Phila.,	Concrete wall on timber platform and piles.	.....	120	.....	.....
Bulkhead behind Pier No. 16, .....	.....	City of Phila.,	Concrete wall on timber platform and piles.	.....	16	.....	.....
Spruce St.—Bulkhead, .....	.....	City of Phila.,	Concrete wall on timber platform and piles.	.....	100	.....	.....
Bulkhead—S. of Spruce St., ..	.....	.....	.....	.....	.....	.....	.....
Pier No. 18,	Boston & Phila. Steamship Co.	.....	.....	.....	.....	Merchants and Miners Trans- portation Co.	.....
Pier No. 20,	Boston & Phila. Steamship Co.	.....	.....	.....	.....	Merchants and Miners Trans- portation Co.	.....
Pine St.—Bulkhead, .....	.....	City of Phila.,	Concrete, deep wall, pile and foundation.	.....	50	Merchants and Miners Trans- portation Co.	.....
							3 mi. from Market St.

DELAWARE RIVER—SOUTH WHARVES—Continued.

Location of Property.	Owner.		Description.	Leases in Force.		Remarks.
	Private.	Public.		Dimensions.		
				Lin.Ft.	Sq.Ft.	
Bulkhead shed S. of Pier No. 38.	.....	City of Phila.,	Proposed,	203x35	7,117	
Bulkhead behind shed, .....	.....	City of Phila.,	Concrete wall on timber platform and piles 150 Lin. Ft. proposed 53 Lin. Ft.	203		
Pier No. 40—N. of Christian St., Bulkhead behind Pier No. 40, ..	.....	City of Phila.,	Proposed,	180x553	99,617	
	.....	City of Phila.,	Concrete wall on timber platform and piles.	183		
Bulkhead S. of Pier No. 40, ..	.....	City of Phila.,	Concrete wall on timber platform and piles.			
Christian St.—Bulkhead, .....	.....	City of Phila.,	Proposed concrete wall on timber platform and piles.	120	.....	1 mi. from Market St.
Pier No. 46,	Penna. R. R. Co.,	.....	.....	.....	.....	International Mercantile Marine Co.
Pier No. 48,	Penna. R. R. Co.,	.....	.....	.....	.....	International Mercantile Marine Co.
Bulkhead N. of Pier No. 49, ..	.....	City of Phila.,	Crib on piles,	26		
Pier No. 49—Washington Ave., ..	.....	City of Phila.,	Crib on piles sub-structure, no super-structure.	60x125	7,500	Pennsylvania R. R. Co.
Bulkhead S. of Pier No. 49, ..	.....	City of Phila.,	Crib on piles,	16		
Pier No. 52,	Penna. R. R. Co.,	.....	.....	.....	.....	International Mercantile Marine Co.
Pier No. 55,	Penna. R. R. Co.,	.....	.....	.....	.....	International Mercantile Marine Co.
Pier No. 57,	Penna. R. R. Co.,	.....	.....	.....	.....	International Mercantile Marine Co.
Reed St.—Bulkhead, .....	.....	City of Phila.,	Concrete wall on timber platform and piles.	56	.....	Pennsylvania R. R. Co.
Pier No. 59,	Spreckles Sugar Refining Co.	.....	.....	.....	.....	1 1/2 mi. from Market St.

SCHUYLKILL RIVER—EAST WHARVES.

Location of Property.	Owner.		Description.	Dimensions.		Leases in Force.	Remarks.	
	Private.	Public.		General.	Lin. Ft.			Sq. Ft.
Fairmount Park—Bulkhead, Springarden St. Bridge—Bulkhead, Bulkhead—S. of Springarden St. Bulkhead—S. of Springarden St. Bulkhead—S. of Springarden St. Bulkhead—S. of Springarden St. Bulkhead—S. of Springarden St. Bulkhead—S. of Springarden St. Bulkhead—S. of Springarden St. Bulkhead—S. of Springarden St. Bulkhead—S. of Springarden St. Bulkhead—S. of Springarden St. Powerton Ave.—Bulkhead, Wood St.—Bulkhead, Bulkhead between Vine and Wood Sts. Vine St.—Bulkhead, Lot behind Bulkhead, Race St.—Bulkhead, Cherry St.—Bulkhead, Lot behind Bulkhead, Market St. Bridge—Bulkhead, .. Lot behind bulkhead, Thos. Lockhart Co. Phila. Elec. Co. H. D. Stratton Ice Co. C. D. Norton, Baltimore & Ohio R. R. Co. Baltimore & Ohio R. R. Co. Knickerbocker Lime Co. Ford & Kendig Co. John Lang Paper Co.							

SCHUYLKILL RIVER—EAST WHARVES—Continued.

Location of Property.	Owner.		Description.		Leases in Force.	Remarks.
	Private.	Public.	General.	Dimensions. Lin. Ft. Sq. Ft.		
Bulkhead—N. of Christian St., Bulkhead—S. of Christian St., Church Bulkhead—R. R. Bridge— Pelz St.—Bulkhead, Ellsworth St.—Bulkhead,	DeTrain Sand Co. Phila. Elec. Co. U. S. Government.	City of Phila., City of Phila.,	Solid crib, sewer outlet,	29 25x90 .....	..... 2,250	5½ mi. from mouth of Schuylkill River. 4½ mi. from mouth of Schuylkill River.
Lot behind Bulkhead, Bulkhead off of the foot of 36th St. Bulkhead N. of Grays Ferry Bridge,	Fred R. Gery Co. Harrison Bros. & Co. B. B. Martin & Co.	City of Phila., City of Phila.,	Bank unprotected,	60 60x130 .....	..... 7,800.....	.....
Grays Ferry Bridge—Bulkhead, ... Lot behind Bulkhead, Bulkhead off of the foot of Wharton St. Bulkhead—N. of B. & O. R. R. Bridge, .....	..... Michael Ehret, Jr., & Co. Phila. Rubber Co.	City of Phila., City of Phila., .....	.....	.....	.....	4 mi. from mouth of Schuylkill River.
Bulkhead—S. of B. & O. R. R. Bridge,	American Incin- erating Co.	City of Phila., .....	.....	.....	.....	.....
Bulkhead—N. of Passyunk Ave. Bridge, .....	.....	City of Phila.,	Miscellaneous,	1,243 .....	.....	23 mi. from mouth of Schuylkill River.
Bulkhead—Passyunk Ave. to 34th St. Lot behind Bulkhead, Passyunk Ave. Bridge—Bulkhead, .....	..... ..... .....	City of Phila., City of Phila.,	Crib on piles, sewer outlet,	100.....	.....	.....
Bulkhead opposite 35th St.,	Girard Estate, ... .....	.....	Unprotected bank, ... .....	..... 50 1,400	.....	1 mi. from mouth of Schuylkill River. 3 mi. from mouth of Schuylkill River.
Penrose Ferry Bridge—Bulkhead, .....	.....	City of Phila., .....	.....	.....	.....	.....
Bulkhead from 26th St. north,	Girard Point Stor- age Co. .....	.....	.....	.....	.....	.....

SCHUYLKILL RIVER—WEST WHARVES.

Location of Property.	Owner.		Description.		Leases in Force.	Remarks.
	Private.	Public.	General.	Dimensions.		
				Lin.Ft.	Sq.Ft.	
Fairmount Park—Bulkhead, .....	.....	City of Phila.,	Solid crib to locks. Dry masonry dam, sewer outlet.	1,780	.....	7 $\frac{1}{2}$ mi. from mouth of Schuylkill River.
Springarden St.—Bulkhead, .....	.....	City of Phila.,	Solid crib,	62	.....	.....
Bulkhead—S. of Springarden St.	Phila. & Read. R. Co. ....	.....	.....	.....	Peoples Bros.	.....
Bulkhead—S. of Springarden St.	Phila. & Read. R. Co. ....	.....	.....	.....	Bernard Connard.	.....
Bulkhead—S. of Springarden St.	Phila. & Read. R. Co. ....	.....	.....	.....	Jos. Burke.	.....
Bulkhead—S. of Springarden St.	Phila. & Read. R. Co. ....	.....	.....	.....	Mrs. J. J. Clancy.	.....
Bulkhead—S. of Springarden St.	Atlantic Refining Co. ....	.....	.....	.....	Barber Asphalt Co.	.....
Bulkhead—S. of Springarden St.	Phila. & Read. R. Co. ....	.....	.....	.....	Henry Holt.	.....
Bulkhead—S. of Springarden St.	Phila. & Read. R. Co. ....	.....	.....	.....	West. Phila. Stock Yard Co.	.....
Bulkhead—S. of Springarden St., Market St.—Bulkhead,	Penna. R. R. Co.	City of Phila.,	Solid crib, sewer outlet.	199	.....	6 $\frac{1}{2}$ mi. from mouth of Schuylkill River.
Chestnut St. Bridge—Bulkhead, .....	.....	City of Phila.,	Bridge abutment, ..	82	.....	.....
Bulkhead—S. of Chestnut St., Bulkhead—S. of Chestnut St., Bulkhead—S. of Chestnut St., Bulkhead—N. of Walnut St. Bridge,	Geo. B. Newton Co. P. H. Fairclamb. Wetherill Bros., Vermont Marble Co. ....	.....	.....	.....	Stokes Bros. Lumber Co.	.....
Walnut St. Bridge—Bulkhead, ..	.....	City of Phila.,	Crib on piles, sewer outlet.	82	.....	6 $\frac{1}{2}$ mi. from mouth of Schuylkill River.
Lot behind Bulkhead, .....	.....	City of Phila.,	.....	80x300	2,400	.....
Bulkhead—S. of Walnut St. Bridge,	Geo. B. Newton Co. ....	.....	.....	.....	Vermont Marble Co.	.....
Bulkhead—S. of Walnut St. Bridge,	Continental Nat'l. Bank, N. Y. City. .....	.....	.....	.....	John Warner Co.,	6 mi. from mouth of Schuylkill River.
Bulkhead—S. of Walnut St. Bridge,	Ready Security Co. ....	.....	.....	.....	Pfutsch Compressing Co.	.....

SCHUYLKILL RIVER—WEST WHARVES—Continued.

Location of Property.	Owner.		Description.	Leases in Force.		Remarks.
	Private.	Public.		Dimensions.		
				Lin.Ft.	Sq.Ft.	
Larchwood Ave.—Bulkhead,	City of Phila.,	Concrete wall on timber platform and piles, sewer outlet.	52		
Lot behind Bulkhead,	City of Phila.,	.....	50x275	13,750	John Maxwell's Sons, Honey & White Co.
Bulkhead—N. of South St. Bridge,	Penna. R. R. Co.,	.....	.....	.....	.....	Franklin Smith.
Bulkhead—N. of South St. Bridge,	City of Phila.,	Concrete on piles, crib on piles.	452		
Lot behind Bulkhead,	City of Phila.,	Slope tripped,	443x251	111,193	John Maxwell's Sons.
South St. Bank under bridge,	City of Phila.,	.....	81	29,000	
Lot behind Bulkhead,	City of Phila.,	Solid crib,	80x250	2,392	Almshouse Wharf.
Wharf S. of South St.,	City of Phila.,	Solid rock and unprotected bank.	54x48	69	
Greys Ferry Bridge—Bulkhead,	City of Phila.,	.....	60x200	12,000	
Lot behind Bulkhead,	Penn Reduction Co.	City of Phila.,	Unprotected rock and bank.	76		4 mi. from mouth of Schuylkill River.
Bulkhead—N. of 49th St.,	City of Phila.,	600' of concrete wall and 717' of river bank unprotected.	70x200	14,000	3 $\frac{3}{4}$ mi. from mouth of Schuylkill River.
49th St.—Bulkhead,	City of Phila.,	.....	1,317		
Lot behind Bulkhead,	City of Phila.,	Concrete wall,	80		3 $\frac{3}{4}$ mi. from mouth of Schuylkill River.
Bartrams Garden—Bulkhead,	City of Phila.,	Unprotected bank,...	73		3 $\frac{3}{4}$ mi. from mouth of Schuylkill River.
Lot behind Bulkhead,	City of Phila.,	.....	.....	.....	3 mi. from mouth of Schuylkill River.
56th St.—Bulkhead,	Gulf Refining Co.,	City of Phila.,	Unprotected bank,...	.....	.....	2 $\frac{3}{4}$ mi. from mouth of Schuylkill River.
Bulkhead—N. of 53th St.,	City of Phila.,	.....	.....	.....	2 $\frac{3}{4}$ mi. from mouth of Schuylkill River.
58th Street Bulkhead,	City of Phila.,	.....	.....	.....	2 $\frac{3}{4}$ mi. from mouth of Schuylkill River.
N. of Passyunk Ave. Bridge—Bulkhead,	Harry D. Beaston,	City of Phila.,	Unprotected bank,...	100		1 $\frac{1}{2}$ mi. from mouth of Schuylkill River.
Passyunk Ave. Bridge—Bulkhead,	City of Phila.,	Bank faced with stone.	201		3 mi. from mouth of Schuylkill River.
Bulkhead S. of Passyunk Ave. Bridge,	Atlantic Refining Co.	.....	Bank slope stonefaced	.....	204,296	
Mingo Creek Pumping Station—Bulkhead,	City of Phila.,	Unprotected bank,...	1,340		
Lot behind pumping station,	City of Phila.,	.....	40		
Cannon Ball Farm—Bulkhead,	City of Phila.,	.....	1,136		
Penrose Ferry Bridge—Bulkhead,	City of Phila.,	.....	.....	.....
Cannon Ball Farm—Bulkhead,	City of Phila.,	.....	.....	.....

At the wharves, docks and ferries along the Delaware and Schuylkill Rivers in Philadelphia, about 24,800 men are daily employed in the various pursuits common to shipping and navigation. 6,000 of these employes work along the Schuylkill and 18,800 work along the Delaware River front.

The piers along the Delaware River are numbered in series. One series begins at Market Street and extends southerly. Another series extends from Market Street northerly to Port Richmond. A third series begins at Port Richmond and extends northerly to the city line.

In 1913, the first series comprised 65 piers; the second series 76 piers; and the third series 28 piers, making a total of 169 piers along the Delaware River.

There are 57 bulkheads or wharves along the Schuylkill River, 35 being along the east and 22 along the west bank thereof. The dredging out of various docks near or into which city sewers empty is done by a municipal plant. In addition to the ordinary solids carried by sewage, large quantities of street dirt are brought down by the sewers and deposited into the River, a considerable part of which settles in the docks, but such sedimentary matter, owing to the open pile construction of most of the wharves, is carried for a considerable distance by the constant tidal movements up and down the river from the actual discharging point of the sewers.

The custom of many owners of the wharves has been to permit the filling up of the docks to a depth making it difficult and frequently dangerous to beach in them. The city has to require such dock owners to dredge out the docks to a depth sufficient to properly accommodate vessels desiring to use them. The depth should be enough so that the docks are available continually for the proper and safe berthing of vessels.

3—*The Schuylkill River Channel.*

The Schuylkill River is a most valuable asset of the Port, and, owing to the U. S. Government's policy of refusing aid to streams similar to it, located entirely within the boundary of one municipality, the maintenance of the channel is one of the duties of the city and the State.

In Director Norris's report for 1912 is the following:

"Nearly fifty per cent. (50%) of the gross export tonnage of the port originates on the Schuylkill River, and the channel is deserving of better treatment than it has heretofore received. The rapid shoaling of this channel is believed to be due, not so much to the amount of silt brought down from the upper reaches of the stream and deposited in tide water near its mouth, as to the constant, gradual oozing into the narrow cut of the improved channel of the soft mud composing the bank and the flats on either side of the stream. In connection with the natural expansion of the city the large improved area along this stream would quickly become desirable manufacturing sites if reclaimed from its present marshy condition. The construction of bulkheads along the river, and the pumping behind these bulkheads of the material which is very desirable to remove from the channel, is the most obvious and most economical method of reclaiming these lowlands. The bulkheading of the stream would prevent the running into the channel of the mud along the bank, and would reduce to a minimum the shoaling of the waterway."

The Schuylkill River channel is now in better condition from its mouth to Walnut Street, as regards depth and navigability, than ever before. The ultimate design is for a thirty-foot channel from the entrance as far as Passyunk Avenue, a twenty-six foot channel from this point to Grays Ferry Bridge, and a twenty-foot channel from here to Walnut Street.

At the conclusion of dredging operations in 1913, the following depths obtained in the channel—center line:

Between the entrance and the Back Channel,.....	30 feet.
From Back Channel to Penrose Bridge,	28 feet.
From Penrose Bridge to Passyunk Avenue,	26 feet.
From Passyunk Avenue to Gibson's Point,.....	29 feet.
From Gibson's Point to Harrison's Wharf,.....	21 feet.
From Harrison's Wharf to Walnut Street,.....	18 feet.

The average width of the Schuylkill between bulkheads is now from 500 to 600 feet. To dredge to this width—the entire prism of the pier to the finishing depth—is unnecessary and unwarranted at this time. Property owners desiring to improve their river frontage in cases where the improved channel is not located immediately along shore in front of the bulkhead, are given substantial co-operation by the city, in extending the limit of the necessary dredging—from a full cut of 200 feet in width—so that they may properly utilize their properties. The city will not take the whole burden of such dredging.

Important legislative enactment (1913) hereinbefore referred to, authorized the city to construct bulkheads along properties on the Schuylkill and Delaware Rivers for the maintenance of the channel, and, eventually, to collect the cost from the owners when actual use of the bulkheads is made. The State may aid.

4.—*The Delaware River.*

a—HARBOR CHANNEL.

The thirty-foot U. S. Government channel in the Delaware River extends officially only as far as Christian Street. The official depth of this channel between Christian Street and Allegheny Avenue is only 26 feet, although throughout the entire section, except for a short length in front of A to G piers, the natural channel is several feet deeper than 26 feet. Some of the largest steamers sailing from the Port now land at piers "A to G" (North Wharves, Port Richmond) and leave there with a draft of 28 feet and more.

Although this section of the river comes within the limits of the approved 35-foot channel project, and is within the jurisdiction of the U. S. Government, the city at its own expense has undertaken to afford temporary relief at Port Richmond to these large vessels. The Federal Government work on the 35-foot channel within the Harbor limits was begun in May, 1914. The head of this channel is just above the piers at Allegheny Avenue.

b—SHIP CHANNEL.

The Delaware ship channel during 1912 had a continuous depth of 30 feet along the entire center line for the first time in its history. The 30-foot channel was begun in 1901, and completed in March, 1911, when the original work was finished. In his report for 1912 Director Norris had this to say about the channel:

"During the ten years of its progress, maintenance work, owing to lack of funds, had not kept up with the original dredging, however, and only about two years before the completion of the last of this "original work" surveys made by the U. S. Engineering Department, under whose charge the improvement was, showed a mean depth over several long shoals—supposed to be completed portions of the channel—of only slightly over 23 feet. Since that time the problem of the continuous maintenance of the channel has been given serious attention, and unremitting work on it has made possible the above result of a practicable 30-foot channel from Philadelphia to deep water in Delaware Bay, a distance of about sixty miles.

"The existence of these shoals had been a source of much annoyance to deep-draft steamers, which had been compelled, in order to successfully pass over them, to take advantage of the higher stages of tide in the River, and it frequently required full tides to enable them to get over the shoals, and make the passage between Philadelphia and deep water in the Bay. The necessity for anchoring between shoals, in connection with the procedure, naturally caused serious delays in the passage of vessels, much irritation on the part of passengers and considerable financial loss to the owners."

"This former difficulty of navigating a channel containing shoals with less actual depth by several feet than the theoretical depth of the channel is now eliminated, and the deepest draft vessels using the port can pass from one end of the River to the other without difficulty and in perfect safety. The improvement in buoyage and lighting of the channel has kept pace with that of the dredging, and it can now be said that Philadelphia has one of the best marked, best maintained, easiest navigated and safest channels of any of the world's great ports."

c—UP-RIVER CHANNEL.

The twelve-foot channel between Philadelphia and Trenton is completed as far as the present steamboat wharves at the lower end of Trenton. The work of extending the channel from that point along the Trenton City front as far as the Pennsylvania Railroad stone arch bridge is now in progress by the U. S. Government. Its completion will place Trenton within easy and economical communication with Philadelphia. It will also complete one more link in the chain of inter-coastal waterways which will eventually connect the whole Atlantic Coast from Maine to Florida in one system.

The commerce carried during the fiscal year ending January 30, 1914, as reported by the U. S. Engineers Department, Philadelphia Office, for this Upper Delaware River Section, amounted to 1,869,521 short tons, and consisted principally of coal, dairy and farm products, sand, gravel, stone, brick and general merchandise. The value of all commerce carried was \$8,914,441.

5.—*Municipal Pier Construction.*

a—*Dock Street Pier*—No. 16 South Delaware Wharves—is a modern, concrete and steel steamship pier, 120 feet wide by 580 feet long, built by the city, and opened January 1st, 1914. Two sunken car tracks run down the center of this pier. They connect the Belt Line Railroad, thus affording access to the tracks of all of the trunk lines entering the city. The structure is electrically lighted inside and out, is provided with portable lights for use inside of the ships tied up at the pier, and railroad cars on it, and has an equipment of portable electric winches for use in supplementing the ship winches used for discharging cargo. One side only has been rented. The other is reserved for the use of steamers not provided with regular quarters elsewhere. There are now but few berths available in the harbor at which such visitors can be accommodated. The pier is located at one of the most convenient points in the harbor, and its facilities have been in much demand. It provides a much needed addition to the facilities of the Port. Though not as large as the Department would have chosen, Director Norris says it is of great service in temporarily relieving the pier shortage now becoming so acute. Owing to this scarcity of present wharf accommodations, the South Side will be maintained for the present as an open pier for the accommodation of all comers, in the order of their arrival and application to space. This dearth of pier accommodations along the main Delaware water front is not a good argument to shipping lines to increase their service, and it is thought advisable under existing circumstances not to rent this half of the pier exclusively to any one company or interest,

and thus remove the Department's only vacant berth from the market, but to reserve it for such occasional vessels as may from time to time be unable to find suitable accommodations elsewhere, until the two additional piers are completed, when the present condition of overcrowding will be much relieved."

b—*The Southwark Piers*—Nos. 38 and 40 South Delaware Wharves—are being constructed between Catharine and Christian Streets, each one of which is 180 feet wide and 550 feet long. They are described by Director Norris as follows: "Their foundations will be of piles and concrete, topped off with a concrete slab floor, and surmounted by a two-story steel and concrete warehouse shed, except at the inshore end where a two-story building will be located. Two sunken car tracks will run down the middle of the piers, and the most modern freight handling equipment will be provided on them for the facilitation of cargo movement. Bulkhead sheds will connect the two piers with each other, and with the Philadelphia and Reading Railway Company's pier—No. 36 South Delaware Wharves—located just to the northward of the group. The docks between the piers will be 200 feet wide, which will provide sufficient space for docking two vessels of large size on either side of the dock with room enough between them to accommodate the usual number of lighters, barges, etc., engaged in taking or loading cargo over the side of the ship."

"Pier No. 36 of the Reading Company is not designed for steamship trade, but for the accommodation of car floats, although inasmuch as the style of architecture of the Delaware Avenue front of the structure will be uniform with that of the municipal piers along side of it, the three will present the appearance of one harmonious group. The style is a modified Romanesque handled in a broad, dignified manner, in concrete, with good lines and proportions, but no unnecessary ornamentation, such being considered superfluous and inappropriate in commercial structures of this character. The entire frontage occupied by them will be more than 1,000 feet in length, and the whole group will be by far the most notable water front improvement ever undertaken in Philadelphia." They will have Belt Line Railroad connections, and be provided with the most up to date equipment of every kind for the economical handling of freight and passengers. One of them will be completed during 1915, and the other the following year. Their approximate cost will be \$1,000,000 each.

c—*Delaware Avenue Bulkhead*—Delaware Avenue is the through pier for handling traffic along the water front. That portion of it between Callowhill Street on the north and South Street on the south is 150 feet wide. This part 1.2 miles was widened and opened in the year 1900. The Delaware Avenue bulkhead—wall extension between South and Christian Streets on the south, and Callowhill Street and Fairmount Avenue on the north, is completed and paved to a width of 150 feet. "This improved marginal street extends for a distance of 1.8 miles abreast of the main business section of the City, along the most used portion of the Delaware water front. The congestion of vehicles and railroad traffic on the old street was such as to cause great delay and expense, and some risk, in connecting with the transportation and local distribution of outbound and inbound steamer freight, and the beneficial effect of the improvement will be immediately felt and appreciated by the water front interests.

"Even in the widened sections of the Avenue there is much congestion of teams at times, caused mainly by the large number of these desiring entrance to certain piers, at certain hours, and by the interference of team movement by railroad trains, either in transit or packed on the tracks. It is absolutely impossible to forbid the free movement of trains at all hours on this street without very seriously

object of this marginal avenue, is to serve as an adjunct to the piers, and a means interfering with car service to the piers, which is out of the question, considered from the standpoint of good policy. The principal, and practically the whole of communication between them. Any interference with its free use for this purpose is improper and unfair to the shipping interests. Rigid traffic rules covering both train and vehicular movements on this street are necessary, and pedestrian traffic across the street should be as nearly completely eliminated as possible."

At the foot of Market and Chestnut Streets there are Ferry Crossings. Boat loads of passengers seriously interfere with team and car movement on Delaware Avenue at these crossings. During certain hours the interference is practically constant. For the safety of the pedestrians and the convenience of the wagon and car operations, this pedestrian traffic should be removed entirely from the street, by the possibility of carrying this traffic over the avenue by foot-bridges running from the easterly side of the avenue up Market and Chestnut Streets to the Front Street intersection. The street grades at these two principal points of crossing Delaware Avenue are favorable for such a plan.

6.—*Notable Private Water Front Facilities.*

Perhaps the most noteworthy private water front facilities are those of the Philadelphia and Reading Company at the Port Richmond terminal docks and piers, and those of the Pennsylvania Railroad Company at Girard Point on the Schuylkill River, and at Greenwich Point on the Delaware. At Port Richmond, beginning at the foot of Cumberland Street and extending northerly, are piers Nos. 18 to 1 inclusive and piers A to J inclusive, owned by the Philadelphia and Reading Railway Company. These terminal facilities cover a continuous stretch of about one mile along the Delaware River. They constitute series No. 3, north wharves. 1,700 men are daily employed at the Port Richmond terminal piers. Pier No. 14 of this series is an iron ore dock provided with modern hoisting apparatus. Pier No. 12 is a modern grain elevator. Piers A to D are export piers and are leased by various ocean steamship lines. Piers G to H are for very heavy freight business and any vessel may dock there having business with the company. Pier J is where cars are loaded on to flat boats for transportation in the harbor. The other piers are coal wharves principally. At Girard Point there are two new concrete piers, a new concrete grain elevator of 1,000,000 bushels storage capacity, and two mechanical ore unloaders with a capacity of 6,000 tons per day. At Greenwich Point there is mechanical car dumping apparatus for the quick loading of coal in vessels.

7.—*Belt Line Railroad.*

The Belt Railroad was conceived and undertaken about twenty-five years ago for the development of the Port. Lack of sufficient capital and of the proper spirit of co-operation between it and the other railroad companies has prevented the thorough co-ordinating of the business of the City's water front. The authorities of the road have not operated cars over it. In fact there is no equipment belonging to the Road, and the tracks are insufficient in length to connect the various working parts of the water front with each other.

Director Norris thinks the Belt Line Railroad should be in the hands of the general port administration, of which it must necessarily be an important, and indeed an essential part. But, in any event, its management, he thinks—should

be independent of and superior to the necessity of operating merely by the grace of the trunk line railroads as at present. This means a complete system of tracks, car storage yards and locomotives for the physical handling of Belt Line trains independent of the railroads contributory to the movement.

Early in the year 1914, a plan was agreed upon by the City, the Belt Line Railroad Company, the Pennsylvania and the Baltimore and Ohio Railroad Companies for the extension of the Belt Line Railroad service, and for the abolition of all grade crossings in South Philadelphia, except on Delaware Avenue, where it is impracticable for the present, and for a short distance on Washington Avenue; the relocation of the lines of the three railroads; the establishment of large car storage and classification yards and steamship terminals by the Pennsylvania and Belt Line Companies between Greenwich Point and the Navy Yard reservation at League Island; the erection of new piers, the incidental extension widening and paving of Delaware Avenue, southward from its present physical terminus at Christian Street to the said yards at Greenwich Point; and for the readjustment of tracks on this street. Before June 30, 1914, contracts were let and work was in progress. A more detailed explanation of this vast improvement is given hereinafter.

About this enormous project Director Norris has the following to say in his 1913 report:

"Belt Line Railroad facilities are guaranteed under the agreement to every wharf on the South Philadelphia water front, and the debilitating effect of the monopolizing of railroad service on piers by one line of railroad only is forever eliminated as a factor in restricting the trade of the Port. One of Philadelphia's most telling arguments and inducements to prospective new entries in the field of steamship service to their Port, has been the existence along the central portion of the river front of a free field for railroad competitors, all the piers between Callowhill and Queen Streets being able to obtain freight service from any one of the great trunk line railroads coming into the City. The new agreement extends this Belt Line service over three miles more of water front. This guaranty of equal service to all piers by all the railroads is one of the strongest safeguards against the possibility of improper attempts at the domination and restriction of water commerce by any one or two interests, however powerful."

"The former development of this section (South Philadelphia) has been in a casual, haphazard manner in pursuance of a hand-to-mouth policy of providing improvements for the needs of the moment, and not much longer. Streets which should be important avenues of traffic are now occupied by surface lines of railroad tracks to the practical exclusion of proper vehicular traffic on them; a considerable portion of the city is blocked off for development by the presence of surface tracks running across town, practically from river to river; a large section of the water front is occupied by these companies, but with such indifferent improvements and facilities, that they are satisfactory neither to the railroad, the city government, nor the public. The new agreement provides a practicable working plan, acceptable, after various compromises, to all interests, under which an extensive and economical utilization of the entire capacity of the water front of this section can be made. In short, by it, order has been established out of chaos."

III. COMPREHENSIVE POLICY FOR PORT IMPROVEMENT.

PROJECTED IMPROVEMENTS—CITY DEPARTMENT OF WHARVES, DOCKS AND FERRIES.

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III. COMPREHENSIVE POLICY FOR PORT DEVELOPMENT.

PROJECTED IMPROVEMENTS — CITY DEPARTMENT OF WHARVES, DOCKS AND FERRIES.

1.—*Need of Increased Facilities.*

The acute necessity for increasing the facilities of the port for handling commerce, has been partially demonstrated in the foregoing presentation of facts and reasoning therefrom. The port is not in a position to offer adequate accommodations for new steamship lines, or for the expansion of existing services. This lack of proper facilities discounts any business campaign that might otherwise be substantially entered into for the radical enlargement of the port business. Director Norris' appeal puts the issue clearly. He said: "The increase in the amount of shipping seeking accommodation in the ports of the Atlantic Coast is inevitably going to be large within the next few years. In the first place, the normal growth of the country and the consequent increase in overseas trade must have accommodations provided for it; secondly, the opening of the Panama Canal, while its precise result is impossible to forecast, will undoubtedly enormously stimulate the interchange of commodities between the Atlantic and Pacific States by sea, the coal and manufactured products of the East being sent westward, and the fruit, oil and lumber of the west being returned in exchange, and thirdly, owing to the fact that the shipping facilities of New York Harbor is as much, if not more, behind the times than other cities in affording the necessary pier accommodations to take care of it, much of the trade formerly going to that port, as a matter of habit, will be seeking other outlets wherever offered."

"This is realized by the New York authorities, as well as those of other ports, and the most tremendous efforts will be made on their part to retain, as heretofore, the lion's share of not only the old, but also the new commerce. That this condition is apparent to practically all of the Port authorities on the Atlantic Coast is evident, and all of them are preparing to fight for this trade to their fullest ability. Boston and Baltimore, our nearest ports and keenest rivals, are fully awake to the situation, and Philadelphia must not only realize it, but must take proper and immediate steps to take full advantage of this rare opportunity."

"That Philadelphia's natural and artificial advantages are not only unexcelled; but approached, by either Boston or Baltimore, hardly admits of controversy. Located on an excellent deep water channel, with a large producing and convenient territory tributary to it, with direct connections to three independent trunk line railroads, Philadelphia's facilities for securing and accommodating a large commerce are of the very first rank. New York offers some questionable advantages to those steamship lines conveying goods destined for consumption by the enormous population composing her metropolitan district, which insures her permanent control of this branch of trade. The transatlantic passenger express traffic is also largely in her hands, and is likely to so remain for several very good and very natural reasons. As far as her facilities for economical handling of goods intended for trans-shipment into the Mississippi Valley and Western States is concerned, however, she cannot now, and never can, compare with Philadelphia, except with the assistance of discriminatory freight rates. The fact that by far the largest number of her wharves are located on the wrong side of the Hudson and East Rivers places upon goods landed at these wharves an extra handling cost so

large that nothing but the assistance of the railroad and steamship lines with unfair freight rates discriminations can enable New York to compete with Philadelphia in this trade. The incidental lighterage charges, to which all of the steamship freight handled in that city is subject, are alone enough to impose a handicap on her commerce sufficiently powerful to enable her rivals to obtain their rightful share, were the fact but realized and acted upon by them."

"In none of these three cities, New York, Boston and Baltimore, is the configuration of the shores surrounding their harbor of such a character as to permit of the same perfect co-ordination between the steamship terminals and the railroads that would be so easy of navigation here in Philadelphia with a little effort on our part."

"The time is ripe for Philadelphia to reassert itself and again take to its old-time place as one of the world's foremost ports. That it is in no position to do so until its docking and railroad facilities are enormously increased needs no argument to any outside mind. Cities, in so far as their piers are concerned, are exactly in the position of landlords of public houses. Such a landlord must needs have accommodations to offer before he can expect to draw trade. His would-be guests cannot deal with him on the basis of future promises, and before he can reasonably ask their patronage he must complete his preparations for housing and feeding them, and be ready to show his accommodations, and demonstrate his ability to administer them. In exactly similar manner a Port desiring to extend its old business and draw new to it cannot deal in vague generalities and promises of possible future accommodations for taking care of it, but must build its piers, its warehouses and railroad connections, and be prepared to make offers of definite service to inquiring steamship companies, instead of indefinite offers based upon hypothetical improvements."

"The City of Philadelphia is now standing face to face with a great opportunity. If it advances to meet it with a rational program of actual accomplishment it can be grasped, to the city's everlasting credit. If it enters upon the campaign with hesitant faith and faltering steps it will meet with nothing but rebuff and failure—and rightly so."

2—*The General Scheme of Development.*

In a number of sections of the present built-up water front of the city, sites are obtainable at reasonable prices, and are suitable in other respects for development. Located in the comparatively central section between Washington Avenue on the south and Columbia Avenue on the north, there are sites for the construction of single piers or small groups of piers of moderate size, for the use of either river or bay or coastwise or ocean freight purposes. According to the general scheme adopted by the city, the first move for the development of the port has been to acquire some of these sites—Dock and Southwark improvements. The second logical move is the gradual extension southward of a comprehensive system of long, wide piers, with adequate car storage yards and other railroad facilities, commencing at Moore Street and extending to the Greenwich piers. This plan keeps actual present conditions in view, and provides for logical expansion. The improvements so far suggested would adequately care for Philadelphia's probable growth of commerce for some time. The section is convenient to railroad connections and trolley lines and for local distribution of freight by truck.

After these facilities are utilized fully, the development of the lower region of the Delaware River front below Greenwich Point and along the lower Schuylkill can be undertaken. To take up these outlying sections first, to the neglect of the obviously far better pier sites nearer the central city, appeared to the Department to be out of the question.

3—*Southwark Piers.*

In keeping with the comprehensive policy outlined, the Southwark piers have been located on the Delaware River front near Christian Street as heretofore described.

4—*Penn Treaty Pier.*

A single pier is projected on the Delaware River front between Columbia Avenue and Palmer Street,—North Wharves. The location is in the heart of a manufacturing district. No wharf capable of accommodating ocean steamers is found for a distance of over a mile on either side. The land is wide, and of such universal depth that it has been planned to locate a series of open-air markets on the plaza between the end of the wharf and Beach Street, upon which the property fronts. The pier is to be 120 feet by 500 feet, of a permanent type of construction, with pile and concrete substruction, surmounted by a two-story shed, equipped with railroad tracks, etc. The market sheds in front of the piers are to be open-sided. The project is estimated to cost \$500,000.

5.—*Moyamensing Improvement.*

The established bulkhead and pierhead lines in the central section of the city fixes and limits the length of the piers to about 550 feet. A pier 1,000 feet long takes up no more bulkhead river than one 500 feet long, and naturally furnishes berthing space for twice as many vessels. All of the present city piers are too contracted in width. Future piers should be not less than 250 feet wide.

The proposed improvement next in chronological order is a group of long, wider piers, to be known as the Moyamensing Improvement, the name being that of the old district of the city in which they are located. There will be ten piers, the first one located at McKean Street and the group extending from that point down to Hoyt street, including the site of the present coal terminals of the Pennsylvania Railroad and Greenwich Point. On the property vacated by the Railroads and some additional frontage of now wholly unused privately-owned property, the ten proposed city piers will be located. These will be of considerably greater size than any now constructed in Philadelphia, it being recognized that the modern cargo-carrying steamer, with an enormously increased freight capacity over those of but a few years back, absolutely requires much greater wharf space.

The new piers will range in length from 900 to 1200 feet and in width from 250 to 300 feet, with docks between them of approximately the same width. The first pier at McKean Street will be 250 feet wider and 900 feet longer—the smallest of the series. The money is in hand for starting this pier. The others are expected to follow as needed from year to year, consistent with the port development. Each pier will be two stories in height, provided with electric lighting and mechanical freight handling equipment, and will afford berthing space for four steamers at one time. Sunken car tracks will run out on the pier for its whole length and ample car storage space will be provided outside of the piers between its entrance and Delaware Avenue to guarantee prompt shifting service of cargo in and out.

"The lack of car storage space near piers is one of the great deficiencies of the present, and makes impossible the rapid discharge and loading of cargo from and to vessels on account of the extreme difficulty, with the present inadequate trackage facilities, of having shifts of cars made in and out of piers as often as desired. The capacity of the standard freight car is only forty or at most fifty tons, and half of this amount, say twenty to twenty-five tons may conservatively be assumed

as the average car load of freight as actually carried. About one-half of the freight received on Philadelphia wharves from over-seas is trans-shipped inland, so that it can readily be seen that literally hundreds of cars are needed to accommodate the freight from only one steamer of fair size carrying from 5,000 to 10,000 tons of cargo. This, of course, necessitates a number of complete changes of cars per day for an active pier, and clearly points out the necessity for commodious car yards as among the immediate adjuncts of steamship terminal piers."

This is why the Director thinks that preferably the movement of these cars should be under the charge of the same management as the water front operations themselves, as they are an essential part of them, or at least under a management independent of control by any one railroad company. Each of the ten big piers is estimated with its equipment to cost \$1,500,000 including property.

6.—*League Island Municipal Docks.*

Between the end of the Moyamensing group, which extends to the present Point House Wharf of the Pennsylvania Railroad Company, and the upper end of the Navy Yard reservation at League Island, ample space is left along the water front opposite the point, freight and car yards of the railroads for construction of such steamship and car float wharves, coaling trestles, and other water front facilities as may be needed by them.

A proposition has been submitted by Director Norris to the Navy Department for the construction of the League Island Municipal Docks, to be located to the southward of these railroad wharves on the Beach Channel in the rear of League Island between Broad Street and the Delaware River. This will be on the north shore of the Channel in the neglected section of the Navy Yard between this inlet and Governor Avenue, which street will mark the boundary of the joint freight yard.

"The improvement proposed is along very simple lines, consisting merely of the formation of a channel of sufficient width and depth for modern steamers by straightening, widening and deepening the present tortuous Back Channel, the construction of a long, substantial concrete quay wall, and on the land back of this wall the erection of a long row of storage warehouses. These sheds will be flanked on both sides by railroad tracks and loading platforms, and served by a number of electric traveling cranes located between the houses and the edge of the quay wall end used for transferring freight to and from the ships and sheds along the quay. This improvement will be very similar in appearance to many European developments, and is the natural and obvious plan to use in this particular locality. About 6,000 feet of quay can be constructed within the limits of the reservation, and considering the large berthing space provided by it, the estimated cost of the entire project, about \$1,000,000, is very low. The close proximity of the largest railroad yards in the city would give it unusual facilities for the economical handling of bulk freight intended for inland points of destination, and its nearness to the industrial factory section, which it is expected will develop just to the northward of these yards would be a great advantage. As director Norris has put it, "The Navy Yard property was presented by the city of Philadelphia to the U. S. Government in 1868. Less than one-third of its more than 900 acres is now occupied by the Navy establishment, and the portion of the yard proposed to be utilized for the above dock has never been used or occupied for any purpose whatever during the history of the Yard, and probably would not be in the natural course of events for many, many years, if ever. It would be so manifestly to the advantage

of the Navy that the city should build this splendid steamship and railroad terminal right at its door, available as it would be, in case of war, as an invaluable addition to the Yard's wharfage and shipping facilities for fitting out and coaling vessels of war, transports, colliers, etc., that no difficulty should be experienced in obtaining the consent of the Government to transfer back to the city's guardianship the small area of land involved, something less than 40 acres of space, or about 4% of its total area."

PROJECTED IMPROVEMENTS—SOUTH PHILADELPHIA, CITY DEPARTMENT OF PUBLIC WORKS.

The proposed engineering works in South Philadelphia, involved in changes in Public Highways, Railroad Facilities, Docks and Piers, as set forth in the agreement authorized by ordinance of the Select and Common Councils of the City of Philadelphia, were approved by the Mayor February 14th, 1914, and a Certificate of Public Convenience therefor was later issued by the Public Service Commission of the Commonwealth of Pennsylvania.

1.—*The Vital Object of The Proposed Changes.*

The plans, comprised in the said agreement, contemplate in their ultimate entirety the utilization of the Delaware River front, and the Schuylkill River front as a water terminal for general commercial purposes, in order that Philadelphia may become as great a factor in the world's trade as other inland ports.

The City Department of Wharves, Docks and Ferries is planning the construction of a number of municipal piers, each pier to be twelve hundred (1200) feet long by three hundred (300) feet wide, with docks between of the same width as the piers and with railroad tracks along the end of the piers, adjacent to the bulkheads,, and paralleling the great public thoroughfare named Delaware Avenue.

West of said Avenue sites for storage warehouses are planned and back of them a factory section is laid out, where manufactories using large quantities of imported raw material, may be established to advantage. Beyond this the section is planned for residential up-building and general development.

The consummation of this project will mean the most extensive, complete and modern steamship and railroad terminal in the world. The work must be done gradually; first, because of its magnitude and cost; and second, because after the first fundamental changes shall have been made, the utilization of the facilities afforded must determine the manner and time of making extension.

To make the primary changes provided for in the said agreement of February, 1914, will require five years. Furthermore, even this start, involves an outlay of \$20,000,000.

2.—*The Extent of City Territory Embraced by the Proposed Changes.*

The South Philadelphia territory to be covered by the projected improvements is about 3 miles long and upwards of 3 miles wide. It is bounded on the east by the Delaware River, on the west by the Schuylkill River, and on the south by the Philadelphia navy yard, which is on League Island in the Delaware River.

From the northern boundary of said district (Christian Street) southerly, for a mile and a half, the territory is closely built up and densely inhabited—excepting the westerly section. Real estate development operations have ceased abruptly at Oregon Avenue. This highway extends east and west across the peninsula. South of Oregon Avenue the land is undeveloped for municipal purposes and much of it is subject to tidal overflow, or would be if it were not for dykes and tide gates.

Midway of the peninsula, and extending north and south, is the thoroughfare known as Broad Street. From Oregon Avenue to the navy yard, this street is now being built by the city as a boulevard with special parkway treatment. The southern section of Broad Street passes through League Island Park, which is also an extensive city project in process of construction.

3.—*Existing Railroad Facilities in South Philadelphia.*

Three railroad companies are involved in the South Philadelphia project; namely, the Pennsylvania Railroad Company, the Baltimore and Ohio Railroad Company, and the Philadelphia Belt Line Railroad Company.

a—THE BELT LINE COMPANY.

The Belt Line Company, although legally a corporation for profit, is in fact a corporation created and existing in the public interest. It is fostered by the city, the trade organizations-control a majority of the stock, the company has no capital, does not build or operate facilities, but owns a franchise route along the Delaware River front and about one-third of the way up the Schuylkill River front. It simply leases transportation right to any railroad company desiring river front facilities. The intent in creating this company was to prevent a monopoly. It has by contract permitted a portion of its route along the Delaware in South Philadelphia to be used by the so-called Delaware Extension of the Pennsylvania Railroad, and by the Baltimore and Ohio Railroad, under terms providing for interchange of traffic.

b—THE PENNSYLVANIA COMPANIES.

1-b—(*Washington Avenue Branch*).

The Pennsylvania Railroad lines enter South Philadelphia from the west, being bridged over the Schuylkill River at two points near the northern boundary of the district.

The old Philadelphia, Baltimore and Washington Railroad—now known as the Washington Avenue Branch—crosses the Schuylkill River immediately south of Gray's Ferry Avenue bridge and extends along its own right-of-way south of and adjacent to the said avenue to Washington Avenue, a distance of about 1 mile, crossing in this length, 17 public highways, all at grade, and the Baltimore and Ohio Railroad, the latter being in tunnel; thence after crossing at grade the Delaware extension of the Pennsylvania Railroad, it extends easterly in Washington Avenue across the city to Delaware Avenue, a distance of 2-3 miles, crossing in this length 30 public highways, all at grade.

At the Broad Street crossing, where formerly was located the old P. B. & W. passenger station, is now located a freight station. East and west of Broad Street in said avenue there are storage tracks. Also along Gray's Ferry Avenue, in the neighborhood of 29th and 30th Streets, there is a storage yard on land owned by the company. Furthermore, for nearly one-half a mile along the Delaware River, at the foot of Washington Avenue, the company has extensive yards, docks and piers.

2-b—(*Delaware Extension*.)

The so-called Delaware Extension of the Pennsylvania Railroad crosses the Schuylkill River opposite Christian Street, via the Arsenal Bridge, this bridge having been built high (some 10 years ago) in anticipation of an elevation of the railroad lines in South Philadelphia; thence it descends to the grade of Gray's Ferry Avenue and Washington Avenue in a distance of less than 2000 feet; thence passing south-erly along 25th Street and across the Baltimore and Ohio Railroad tracks, a total

distance of about 2 miles, it crosses 8 public highways, all at grade, the last one being Passyunk Avenue, making 10 street crossings to this point; thence it extends easterly in a straight line along the company right-of-way to the Pennsylvania Company's piers at Greenwich Point on the Delaware River, where the company has extensive land holdings and terminal facilities. Along this easterly stretch of 3 miles of main running track, 4 public highways are crossed, all at grade. Extensive freight classification yards abut the line. The land is unimproved adjoining the tracks. Thence the Delaware Extension passes northerly in Swanson Street and in Delaware Avenue, a distance of $1\frac{1}{4}$ miles to Washington Avenue and the yards and piers of the Pennsylvania Company lying between Reed Street and Queen Street; thence the said Delaware Extension tracks are laid northerly in Delaware Avenue by agreement with the said Belt Line Company.

Along the lines of the Delaware Extension between Greenwich Point and Washington Avenue, 15 streets are crossed, all at grade.

3-b—(*Girard Point Branch*).

The Girard Point Branch of the Delaware Extension, begins at the South end of the 25th Street line, near Bigler Street, and pursues a circuitous course to the west and south, terminating south of Penrose Avenue at the Girard Point Storage Company's yards, piers and grain elevators on the Schuylkill River, the length of this branch being approximately 1 1-3 miles, along which 3 highways are crossed, all at grade.

4-b—(*Schuylkill River Branch*.)

The Schuylkill River Branch extension is a prolongation of the Girard Point Branch easterly to Broad Street and the Philadelphia navy yard, a distance of $1\frac{1}{4}$ miles, in which 1 street only is crossed and that at grade.

Excluding Delaware Avenue and Swanson Street, where changes do not involve the abolition of grade crossings, it appears that the Pennsylvania Railroad Companies maintain 67 grade crossings of highways in South Philadelphia.

c—THE BALTIMORE AND OHIO COMPANIES.

1-c—(*Schuylkill River East Side Railroad*.)

The Baltimore and Ohio Railroad also enters South Philadelphia in the northwest corner of the district, crossing the Schuylkill River 2000 feet downstream from the Philadelphia, Baltimore and Washington River bridge, and extending northerly under Schuylkill Avenue and Wharton Street and by tunnel under Gray's Ferry Avenue and the tracks of the P. B. & W. Railroad, and along the river under the tracks of the Delaware Extension near Christian Street to the main passenger station near Market Street, in the centre of the city.

The said B. & O. Company owns property abutting the Schuylkill River, beginning at its said river bridge and extending southerly for 3-5 of a mile. The land is utilized for yards and repair shops. From these yards there is a main running line, known as the Schuylkill River East Side Railroad, which extends easterly along the bed of Wolf Street (not physically opened) for a distance of over a mile and, crossing the tracks of the Delaware Extension, turns southerly and extends in 23rd Street for one-third of a mile; thence easterly in Oregon Avenue and thence northerly in said street and avenue to the yards, piers and terminal facilities of the Baltimore and Ohio Company, in the vicinity of Snyder Avenue. This branch up to Vandalia Street crosses 8 highways, all at grade.

Thence the tracks continue northerly from Snyder Avenue up to Delaware Avenue and Vandalia Street for 3-5 of a mile or more to other yards, piers and terminal facilities of the Baltimore and Ohio Company along the river between Tasker and Dickinson Streets, there being a belt line connection at this point between Vandalia Street and Swanson Street.

Along the lines of the B. & O. Company in Vandalia Street and Delaware Avenue 10 streets are crossed, all at grade. Excluding these crossings, because the proposed changes do not involve their abolition, it appears that the Baltimore and Ohio Company maintains 8 grade crossings of highways in South Philadelphia.

4—*Tabular Statement of Existing Crossings of Railroads and Public Highways in South Philadelphia.*

TABULAR STATEMENT.

Number.	Public highway.	Trolley tracks.	Mode of Protection.			Proposed changes.
			Gates.	Flagman.	Stationed flagman.	
PENNSYLVANIA COMPANIES. (Washington Ave. Br.)						
1	S. 36th St., .....	.....	.....	Yes	.....	None
2	Harmony St., .....	.....	.....	Yes	.....	None
3	S. 36th St., .....	.....	.....	.....	No	None
4	Sedwyck St., .....	.....	.....	.....	No	None
5	S. 34th St., .....	.....	.....	.....	No	None
6	S. 33d St., .....	.....	Yes	.....	.....	None
7	S. 32d St., .....	.....	.....	Yes	.....	None
8	Patton St., .....	.....	.....	.....	No	None
9	Napa St., .....	.....	.....	.....	No	None
10	S. 31st St., .....	.....	Yes	.....	.....	None
11	S. 30th St., .....	.....	.....	Yes	.....	None
12	S. 28th St., .....	.....	Yes	.....	.....	Underpass
13	Federal St., .....	.....	Yes	.....	.....	Underpass
14	Annin St., .....	.....	.....	.....	No	Underpass
15	Ellsworth St., .....	.....	.....	Yes	.....	Underpass
16	S. 27th St., .....	.....	.....	Yes	.....	Underpass
17	S. 26th St., .....	.....	.....	Yes	.....	Underpass
18	S. 25th St., .....	.....	.....	.....	No	Underpass
19	S. 24th St., .....	.....	.....	Yes	.....	Underpass
20	S. 23d St.,	Single	Yes	.....	.....	Underpass
21	S. 22d St.,	Single	Yes	.....	.....	Underpass
22	S. 21st St., .....	.....	Yes	.....	.....	Underpass
23	S. 20th St.,	Single	Yes	.....	.....	Underpass
24	S. 19th St.,	Single	Yes	.....	.....	Underpass
25	S. 18th St.,	Single	Yes	.....	.....	Underpass
26	S. 17th St.,	Single	Yes	.....	.....	Underpass
27	S. 16th St.,	Single	Yes	.....	.....	Underpass
28	S. 15th St.,	Single	Yes	.....	.....	Underpass
29	S. Broad St., .....	.....	.....	.....	No	Underpass
30	S. 13th St.,	Single	.....	.....	No	Underpass
31	S. 12th St.,	Single	.....	.....	No	Underpass
32	S. 11th St.,	Single	.....	.....	No	Underpass
33	S. 10th St.,	Single	.....	.....	No	Underpass
34	S. 9th St.,	Single	.....	.....	No	Underpass
35	S. 8th St.,	Single	.....	.....	No	Underpass
36	Passyunk Ave.,	Single	.....	.....	No	Underpass
37	S. 7th St.,	Single	.....	.....	No	Underpass
38	S. 6th St.,	Single	.....	.....	No	Underpass
39	Randolph St., .....	.....	.....	.....	No	Vacated
40	S. 5th St.,	Single	.....	.....	No	None
41	S. 4th St.,	Single	.....	.....	No	None
42	S. 3d St.,	Single	.....	Yes	.....	None
43	Moyamensing Ave., .....	.....	.....	.....	No	None
44	S. 2d St.,	Single	.....	Yes	.....	None
45	Front St., .....	.....	.....	.....	No	None
46	Water St., .....	.....	.....	.....	No	Vacated
47	Swanson St., .....	.....	.....	Yes	.....	None
		21	13	11	23	

TABULAR STATEMENT—Continued.

Number.	Public highway.	Trolley tracks.	Mode of Protection.			Proposed changes.
			Gates.	Flagman.	Stationed flagman.	
PENNSYLVANIA COMPANIES.						
(Delaware Extension.)						
48	Gray's Ferry,	Double	Yes	.....	.....	Underpass
49	Washington Ave., .....	.....	.....	.....	No	Underpass
50	Ellsworth St.,	Single	Yes	.....	.....	Underpass
51	Federal St., .....	.....	Yes	.....	.....	Underpass
52	Wharton St.,	Single	Yes	.....	.....	Underpass
53	Dickinson St., .....	.....	Yes	.....	.....	Underpass
54	Tasker St.,	Single	Yes	.....	.....	Underpass
55	Morris St.,	Single	Yes	.....	.....	Underpass
56	Pt. Breeze Ave.,	Double	Yes	.....	.....	Underpass
57	Passyunk Ave.,	Double	Yes	.....	.....	R. R. Vacated
58	Penrose Ave., .....	.....	.....	Yes	.....	R. R. Vacated
59	Moyamensing Ave.,	Double	Yes	.....	.....	R. R. Vacated
60	League I. Rd., .....	.....	.....	.....	No	R. R. Vacated
61	Stonehouse Rd., .....	.....	.....	.....	No	R. R. Vacated
14		8	10	1	3	
(Branch to U. G. I.)						
62	S. 28th St., .....	.....	.....	Yes	.....	Underpass
63	Jackson St., .....	.....	.....	Yes	.....	Underpass
2				2		
(Girard Point Branch.)						
64	Puddlehole L., .....	.....	.....	.....	No	R. R. Vacated
65	Magazine L., .....	.....	.....	.....	No	R. R. Vacated
66	Penrose Ave.,	Double	Yes	.....	.....	Underpass
3		1	1		2	
(Schuylkill River Extension Branch.)						
67	S. Broad St.,	Double	.....	.....	No	Overpass
1		1			1	
(Swanson St. and Delaware Ave. Branch from Greenwich Point to Washington Ave.)						
Swanson St.						
68	Wolf St., .....	.....	.....	Yes	.....	None
69	Jackson St., .....	.....	.....	.....	No	None
70	Snyder Ave., .....	.....	.....	Yes	.....	None
71	Mifflin St., .....	.....	.....	Yes	.....	None
72	Moore St., .....	.....	.....	.....	No	None
73	Morris St., .....	.....	.....	Yes	.....	None
74	Tasker St., .....	.....	Yes	.....	.....	None
75	Dickinson St., .....	.....	Yes	.....	.....	None
76	Reed St., .....	.....	Yes	.....	.....	None
77	Ellsworth St., .....	.....	.....	Yes	.....	Vacated
Delaware Ave.						
78	Greenwich Pt., .....	.....	.....	.....	No	R. R. Relocated
79	Weccacoe Ave., .....	.....	.....	.....	No	R. R. Relocated
80	Snyder Ave., .....	.....	.....	.....	No	None
81	Mifflin St., .....	.....	.....	Yes	.....	None
82	Morris St., .....	.....	.....	Yes	.....	None
15			3	7	5	

TABULAR STATEMENT—Continued.

Number.	Public highway.	Trolley tracks.	Mode of Protection.			Proposed changes.
			Gates.	Flagman.	Stationed flagman.	
BALTIMORE AND OHIO COMPANIES.						
(Schuylkill River East Side Branch.)						
Main Line to Vandalia						
83	S. 28th St.,			Yes		R. R. Vacated
84	Passyunk Ave.,	Double	Yes			R. R. Vacated
85	Penrose Ave.,				No	R. R. Vacated
86	S. 20th St.,				No	R. R. Vacated
87	Moyamensing Ave.,	Double	Yes			R. R. Vacated
88	S. Broad St.,	Double	Yes			R. R. Vacated
89	League I. Rd.,				No	R. R. Vacated
90	Stonehouse L.,				No	R. R. Vacated
8		3	3	1	4	
Vandalia St.						
91	Wolf St.,				No	None
92	Weccacoe Ave.,				No	None
93	Snyder Ave.,				No	None
94	Mifflin St.,			Yes		None
95	Morris St.,			Yes		None
96	Tasker St.,			Yes		None
97	Dickinson St.,				No	None
98	Reed St.,				No	None
8				3	5	
Delaware Ave.						
99	Snyder Ave.,				No	R. R. Relocated
100	Mifflin St.,			Yes		None
2				1	1	

There is a total of 100 crossings at grade of highways and railroads in South Philadelphia. Thirty-four of these highway crossings have trolley tracks in them. At 44 of the crossings there is no safety device used or protection afforded such as gates or a watchman. At 30 of the crossings, gates are provided and at 26 of the crossings a flagman is stationed. The Pennsylvania Companies maintain 82 of the crossings, and the Baltimore Companies the remainder.

In the Delaware River zone, including the piers, yards and terminal facilities and the industrial plants where it is not contemplated to abolish grade crossings for obvious reasons, there are, excluding numerous switches on to piers, warehouses and industrial works and freight yards, 25 main highway grade crossings, of which the Pennsylvania Companies maintain 15 and the Baltimore and Ohio Companies the remainder. In this zone there are no trolley tracks crossing the railroads. But three of these crossings are now protected by gates; 11 of them have a flagman, and 11 are unprotected.

5—The General Plan of Improvements.

Briefly, the comprehensive plan comprises the building of a Joint Belt Line Railroad along the water boundaries of South Philadelphia, and the abandonment by the railroad companies of all the tracks, lands and facilities inside of this Belt Line zone.

In connection with such readjustment of the railroad line a revision of the lines and grades of streets throughout the unimproved area lying between the two rivers, is contemplated. This will provide better opportunities for transportation and development of the territory for commercial, industrial and residential purposes, and assures wide streets, plenty of diagonals, large house lots and the setting aside at proper distances of small parks and play-ground areas.

Furthermore, to aid in carrying out the city's plans for the improvement of the Port, the Baltimore and Ohio Company will give up its Snyder Avenue yards and terminal facilities, and the Pennsylvania Railroad will give up its Greenwich Point yards, plant and terminal facilities; and as a substitute therefor, the project provides for new terminal yards and facilities to be built along the Delaware River adjacent to the navy yard.

The city will acquire the said Baltimore and Ohio property at Snyder Avenue, including about 900 feet river frontage, and also the Pennsylvania Companies' property at the Greenwich terminals, including about 2500 feet of river frontage. With these and the intervening land along the Delaware River, easy of acquisition by the city, there will be a total distance of 7200 feet available for a symmetrical, economical and efficient municipal steamship terminal development requisite for the proper handling of the enormous cargoes carried by modern ocean freighters, and for the prompt dispatch of cargo to and from the wharves.

a—THE PENNSYLVANIA RAILROAD CHANGES.

1-a—(*Washington Avenue Branch.*)

The proposed changes of the Washington Avenue Branch, as provided for in the said agreement, are briefly as follows:

No change is to be made for the present in the existing tracks along Gray's Ferry Avenue from the Schuylkill River to 30th Street. Hence, 11 street crossings will be continued at grade. Ultimately they will be abolished as grade crossings.

From 31st Street to 25th Street, along Gray's Ferry Avenue, the railroad will continue to occupy its present location, but it is to be reconstructed as a two-track elevated railroad on a new grade over all intersecting streets; thence from 25th Street to 6th Street, said branch is to be reconstructed as an elevated railroad along Washington Avenue, with 3 tracks to 17th Street and then 2 tracks to 6th Street, on a new grade over all intersecting streets. The 27 existing highway crossings along said track elevation are to be continued, but the railroad is to pass over them with a clear head room of at least 14 feet. Thence by 2 tracks on earth embankment filled between retaining walls, the new railroad will descend to grade with tracks (present or revised) on Washington Avenue near 5th Street and thence easterly as a surface line to Delaware Avenue. In this distance, 2 highway grade crossings are to be vacated and 7 highway grade crossings are to be permanently continued. The following is a crossing summary for the Washington Avenue Branch:

WASHINGTON AVENUE BRANCH.

Grade crossings to be abolished	
by street vacation,	2
by railroad passing over,	27
Grade crossings to remain at grade	
for the present,	11
permanently,	7
Total existing grade crossings,	47
Grade crossings to be abolished	
now,	29
in future,	11
Total to be abolished,	40
Permanent grade crossings,	7
	47

A storage yard on Washington Avenue between 18th and 19th Streets is provided to replace the storage facilities now in and along Washington Avenue. Likewise, enlarged storage and delivery yards and facilities are to be provided between Reed Street and Washington Avenue and between Front Street and the Delaware River. These 4 highways are to be widened and improved. In the territory so bounded all other streets are to be vacated.

The present freight station on Broad Street is to be elevated to the same grade as the new tracks and is to be provided with inclined driveways from the street to the reconstructed carload delivery yard.

2-a—(Delaware Extension Branch.)

The Delaware Extension will continue to occupy its present location from the Arsenal Bridge at the Schuylkill River to Point Breeze Avenue. This line is to be reconstructed as a two-track elevated railroad on earthen embankment, between retaining walls from said River to Washington Avenue and thence by an elevated viaduct, of metal, concrete or masonry construction, along 25th Street as widened and improved, to the north side of Point Breeze Avenue. Up to this point there are 9 existing highways crossing the railroad; they will become underpasses, and in addition there are 6 other streets which are paved and curbed, and built up to the railroad or near it, that will be physically opened under the elevated railroad. They are Manton, Oakford, Reed, Moore, Mifflin and McKean Streets.

From Point Breeze Avenue onward, the present location of the tracks is to be abandoned. The new line as a two-track elevated structure is to extend along Point Breeze Avenue, as widened and improved, to Vare, Wolf and 29th Street intersection. In this distance there are 2 highway grade crossings. They will pass under the railroad, and in addition 3 new highway grade crossings will be opened under, namely: 26th Street and Snyder Avenue, 27th Street, and Vare Avenue and 29th Street.

From said intersection, the said elevated two-track railroad will continue; but on an earthen embankment and right-of-way adjacent to and west of 29th Street, as revised, (and alongside a similar two-track structure to be built by the B. & O. Company), to Passyunk Avenue; thence as a four-track elevated joint line, (the two easterly tracks for the P. R. R. Co., and the two westerly tracks for the B. & O. Company), in and along 29th Street as it is to be laid out, widened and improved, to Magazine Lane, where the right-of-way for the Philadelphia Belt Line double track begins.

Beyond Magazine Lane, the right-of-way is made wide enough for 6 tracks—2 for the Penna. Company, 2 for the B. & O. Company and 2 for the Philadelphia Belt Line Company. A joint elevated four-track line, with right-of-way for 2 additional tracks, is to be built south of Magazine Lane to Penrose Avenue, on land adjacent to and west of 29th Street. The construction, probably will be earthen embankment; thence the same kind of an elevated structure will extend eastward on property of the Girard Point Storage Company (subsidiary to the Pennsylvania Company) to 26th Street as proposed; thence as a six-track incline through League Island Park and under Broad Street to a connection with the new terminal railroad yard.

Along this elevated line, from Point Breeze Avenue, there are the following streets to be passed over by the new railroad: Passyunk Avenue, Oregon Avenue, Magazine Lane, Penrose Avenue and Broad Street. In addition, the following streets will be opened and passed under the said elevated structure: Pollock, Hoyt, Unnamed, Pennypacker, Beaver and 26th Streets.

The new railroad is to be of such an elevation throughout as to give not less than 14 feet clearance above grade of all intersecting streets or longitudinal streets now opened or agreed to be opened.

East of Broad Street, the joint four-track railroad and a right-of-way reserve for the double tracks of the Belt Line Company, will extend along the new Pennsylvania Railroad Terminal Yards as a surface line, and by Vandalia Street to Delaware Avenue as relocated and improved; thence north on said Avenue, as a joint surface line, the 2 tracks of the Pennsylvania Company connecting with the present tracks of said company as relocated to Vandalia Street; thence by the 3 tracks of said Company in said Avenue to Queen Street.

A single track switching line is to be constructed at grade from the new main line northerly in Vandalia Street to beyond Packer Street, there to connect at Pollock Street with the present tracks of said company in Swanson Street.

The Girard Avenue Branch is to be abandoned. The yards and terminal tracks of the Pennsylvania Company at Girard Point must be elevated and be connected to the main running tracks. The Schuylkill River Branch also is to be abandoned, the main line taking its place.

Broad Street is to pass over the joint railroad line with a clearance of not less than 19 feet. All the traffic into the new railroad terminal yards, to and from the west, must pass under this highway bridge.

The following is a crossing summary for the Delaware Extension:

DELAWARE EXTENSION.

Grade crossings to be abolished	
by railroad passing over,	12
by railroad passing under,	1
by vacation of railroad,	7
Total,	20
Streets to be passed under the railroad	
by existing grade crossings,	12
by new street openings,	15
by streets now open,	3
new crossings,	18
Streets to be passed over the railroad,	1
Total permanent crossings (none at grade),	31

So there are 20 grade crossings now. After the Delaware Extension changes are made, 7 of these crossings will have been obviated by the abandonment of the railroad, 12 of the grade crossings will have been abolished by the railroad passing over and 1 by the railroad passing under. The new railroad will pass over 15 newly opened streets and over 3 existing highways at new points of crossing; hence when the changes are all made, there will be along the Delaware Extension 31 crossings, none at grade, where now there are 20 crossings all at grade.

b—THE BALTIMORE AND OHIO RAILROAD CHANGES.

(Schuylkill River East Side Railroad Branch.)

The proposed changes of the Schuylkill River East Side Railroad Branch of the Baltimore and Ohio Company, as provided for in the said agreement, are briefly as follows:

The tracks of the Baltimore Companies are to remain in the present location from the East Side Yard easterly to 30th and Wolf Streets; but they are to be elevated as a two-track railroad on earthen embankment, passing in this length over Schuylkill Avenue as it is to be opened.

From 30th Street onward, the present location of the tracks is to be abandoned, and thus the existing grade crossings (8 in number) will be abolished. The new line as a two-track elevated railroad will curve south into a right-of-way west of and adjoining the tracks of the Delaware Extension Branch of the Pennsylvania Companies (as relocated and reconstructed), and along said Delaware Extension on an earthen embankment to Passyunk Avenue where it will connect with the proposed joint four-track elevated railroad line, and thence as a four-track joint line to Magazine Avenue, all as hereinbefore described; thence continuing from this point as said joint four-track line of the Pennsylvania and Baltimore Companies, but with an additional right-of-way for 2 tracks of the Philadelphia Belt Line Company to Vandalia Street and Delaware Avenue, all as hereinbefore described under Pennsylvania Railroad changes; thence the Schuylkill River East Side Railroad is to continue parallel and adjacent to the Pennsylvania Companies' tracks and reserve space for the Belt Line tracks, along Delaware Avenue to Vandalia Street near Moore, there connecting with the existing tracks of the Baltimore and Ohio Companies in Vandalia Street. Said tracks in Vandalia Street are to be extended as a single track switching line south in the bed of said street from Oregon Avenue to a connection with the relocated main line near Patterson Street.

East of Broad Street the 2 tracks of the said Schuylkill River East Side Branch are to connect with the terminal yards to be constructed by the Baltimore and Ohio Companies between Broad Street and the Delaware River and south of the new terminal yards of the Pennsylvania Companies.

When these changes shall have been made, 8 highway grade crossings of the Baltimore and Ohio tracks will have been abolished by the removal of the railroad, and 1 new crossing will have been established, the railroad passing over the street, i. e. that portion of the railroad which is independent of the joint line proposed.

6.—*Tabular Statement of Crossings on Completion of Changes Proposed.*

TABULAR STATEMENT OF CROSSINGS OF RAILROADS AND HIGHWAYS AS THEY WILL EXIST IN SOUTH PHILADELPHIA ON COMPLETION OF THE CHANGES PROPOSED TO BE MADE IN THE NEXT FIVE YEARS.

Classification of Crossings.	Washington Ave. Branch.	Delaware Extension Branch.	Totals.		
			Penna. Railroad.	B. & O. Railroad.	Grand total.
Grade crossings abolished:					
By R. R. over St.—now,	27	12	39	.....	39
By R. R. over—future,	11	.....	11	.....	11
By R. R. under—now, .....	.....	1	1	.....	1
By vacation of St.—now,	2	1	3	.....	3
By vacation of R. R.—now, .....	.....	9	9	.....	18
Totals,	40	23	63	9	72

TABULAR STATEMENT OF CROSSINGS OF RAILROADS, ETC—Continued.

Classification of Crossings.	Washington Ave. Branch.	Delaware Extension Branch.	Totals.		
			Penna. Railroad.	B. & O. Railroad.	Grand total.
New crossings—Streets under:					
New street openings, .....	.....	15	15	1	16
At streets now open, .....	.....	3	3	.....	3
Totals, .....	.....	18	18	1	19
Permanent grade crossings:					
Along Delaware Ave., .....	.....	3	3	1	4
Along Swanson St., .....	.....	9	9	.....	9
Along Vandalia St., .....	.....	.....	.....	8	8
Elsewhere in district,	7	.....	7	.....	7
Totals,	7	12	19	9	28
Total permanent crossings:					
At grade,	7	12	19	9	28
Not at grade,	33	31	69	1	70
Totals,	45	43	88	10	98

When the changes are completed that are called for in the said agreement between the city and the railroad companies, there will remain 28 permanent railroad and highway grade crossings, and there will be 70 other crossings where the railroad will pass over the street, with one exception in which it will pass under the street.

Twenty-one grade crossings will be abolished by the closing up of the street or railroad. Nineteen new crossings will be established—none at grade. Fifty-one existing grade crossings will have been continued other than grade crossings. So while there are now 100 existing grade crossings, then there will be 98 crossings of which 28 only will be at grade. However, it may be that the abolition of the 11 grade crossings along Gray's Ferry Avenue may not have been accomplished at the close of the year 1919, since this project is beyond that for which the money has been provided.

As the plans according to which all these crossings are to be built, are worked out, they will be submitted to the Public Service Commission for approval. It is possible that other crossings may be planned by the city. If so, the plans must also be submitted for approval to the Public Service Commission, and, necessarily, all these plans must be in general conformity with the comprehensive scheme as hereinbefore outlined.

7—How and by Whom, the Work is to be Done.

The Pennsylvania Companies and the Baltimore Companies will prepare the plans and specifications and do the work of changing, widening and improving, relocating and extending, constructing and reconstructing and elevating their respective railroads, tracks, yards, terminals, freight and coaling stations, signal towers and other structures and their appurtenances; and all operating appliances such as telegraph, telephone and the electric light facilities, block signals, interlocking plants, etc.

The city will revise the lines and grades of streets as may be necessary, and vacate other streets for the execution of the work to be co-operatively undertaken and completed by the railroad companies and city in accordance with the said agreement.

The city will also prepare the plans and specifications and do the work of grading, paving or repaving, setting or resetting of curbs, upon streets now opened and involved; the grading and drainage of streets to be paved; the construction and reconstruction, alteration or removal of all sewers, water and gas mains, electric conduits and municipal structures; all street improvements including the underpinings or removal of buildings adjacent to the work.

The following main highways are to be opened and graded full width or as revised under the said agreement:

25th Street from Washington Avenue to Point Breeze Avenue,
 Point Breze Avenue from 25th Street to Wolf Street,
 29th Street from Passyunk Avenue to Magazine Lane,
 Delaware Avenue from north side of Bigler Street to north line of proposed terminal yards of P. R. R.

In the future, if the city should desire to open any street or avenue, not at grade but at grade but over or under the elevated and reconstructed railroads, in addition to the crossings now provided for, such new crossing shall be so opened at the equal cost and expense to the city and the railroad company; but such crossings are not to require any change in the grade of the said elevated or reconstructed railroad; provided, however, that the crossing at grade of surface tracks may be made at Swanson Street, Vandalia Street and Delaware Avenue north of the point where the main running tracks of the railroads as relocated, enter said streets and avenue.

The city is to vacate all streets and avenues that now pass through the property to comprise the new terminal yards of the railroad companies between Broad Street and the Delaware River.

The existing sidings into various industrial plants will be replaced north of Jackson Street by proper and satisfactory connection with the relocated, reconstructed and elevated lines of railroad, in all cases where satisfactory plans can be worked out, the cost of such work, to the property line, is to be shared jointly by the city and railroad; but the work on the property is to be done wholly at the cost of the owner thereof. These crossing plans are to be approved by the Public Service Commission, as must all future sidings and connections to industries, commercial establishments, warehouses, piers, etc.

Article Fourteenth of the agreement is as follows:

"It is mutually understood and agreed that the work contemplated and to be done under this agreement for which the cost is to be apportioned between the city and the Pennsylvania Companies and the Baltimore Companies other than that herein specifically provided for, shall consist only of that which may be necessary to provide the various railroad lines affected with real estate equal in area, and tracks and facilities for the handling of railroad traffic equal to those now used and enjoyed by them. And only such changes of physically and legally opened streets and municipal structures as may be necessitated by the changing, construction, reconstruction or elevation of the railroad lines under, over and adjoining such streets. Except as herein otherwise specifically provided for, all real estate for yards, rights-of-way or other railroad purposes and all construction work, including all labor,

structural work, and material required for the same, intended to increase the traffic facilities of the said railroad companies, all new freight depots, signal towers, signals, telegraph or telephone stations or other appurtenances or improvements intended to increase traffic facilities and all changes or improvements to existing stations and appurtenances other than those required to adapt the present traffic facilities and appurtenances to the new conditions shall be wholly paid for by the said companies respectively."

The detailed plans for all these changes are now being prepared. When completed, such of these plans and specifications as are to be acted upon by the Public Service Commission, will be submitted to said Commission for approval.

8—Apportionment of Cost.

APPORTIONMENT OF THE COST OF RE-LOCATING AND ELEVATING TRACKS AND FREIGHT TERMINALS OF PENNSYLVANIA RAILROAD COMPANY, PHILADELPHIA, BALTIMORE AND WASHINGTON RAILROAD COMPANY, AND THE BALTIMORE AND OHIO RAILROAD COMPANY IN SOUTH PHILADELPHIA.

Items.	Penna. Co.'s portion.	B. & O. R. R. Co.'s portion.	City of Phila.'s portion.
WASHINGTON AVE. BR. P. P. & W. R. R.			
Wash. Ave. Elevated Railroad 30th St. to Gray's Ferry Ave. to west side of Broad St. (2 tracks, 30th St. to 25th St.; 3 tracks, 25th St. to 17th St. and 2 tracks, 17th St. to Broad St.)	$\frac{1}{2}$ cost	.....	$\frac{1}{2}$ cost
West side of Broad St. to 5th St. (2 tracks),	$\frac{3}{4}$ cost	.....	$\frac{3}{4}$ cost
New freight station and elevated yard tracks between Broad St. and 17th St.	$\frac{1}{4}$ cost	.....	$\frac{1}{4}$ cost
Car storage yards south of Washington Ave. between 18th St. and 19th St.	$\frac{1}{2}$ cost	.....	$\frac{1}{2}$ cost
DELAWARE EXTENSION P. R. R.			
Two-track elevated railroad (steel viaduct on 25th St. from Arsenal Bridge to McKean St. thence along Pt. Breeze Ave. to 29th St. thence embankment to Passyunk Ave.	$\frac{1}{2}$ cost	.....	$\frac{1}{2}$ cost
Three yard tracks from Magazine Lane to Penrose Ave. to replace tracks on Girard Pt. Br.	$\frac{1}{2}$ cost	.....	$\frac{1}{2}$ cost
Girard Pt. Storage Co.'s tracks and elevation to connect with joint line.	$\frac{1}{2}$ cost	.....	$\frac{1}{2}$ cost
Two tracks on Delaware Ave. from Bigler St. to Swanson St. to be relaid with girder rails; paving Delaware Ave. from Reed St. to Queen St.; purchasing Reed St. property and rebuilding yards and tracks to compensate for tracks removed from Delaware Ave. and to permit widening of Reed St., Front St. and Washington Ave.	$\frac{1}{2}$ cost	.....	$\frac{1}{2}$ cost
Additional yard facilities required by P. R. R. Co. Reed St. and Washington Ave.	entire cost	.....	.....
New terminal yards between Broad St. and Delaware Ave., not including pier development. Portion to be paid jointly by city and P. R. R. Co. to replace present facilities and provide for dredging.	$\frac{1}{2}$ cost	.....	$\frac{1}{2}$ cost

APPORTIONMENT TABLE—Continued.

Items.	Penna. Co.'s portion.	P. & O. R. R. Co.'s portion.	City of Phila.'s portion.
Additional facilities to be constructed entirely at P. R. R. Co.'s expenses.	entire cost	.....	.....
No. 1—piers, tracks, etc., Delaware Ave. to pier head line and Bigler St. to Hoyt St.	.....	.....	entire cost
To replace above water front facilities on property now owned by P. R. R. Co. south of Hoyt St.	entire cost	.....	.....
JOINT FOUR-TRACK LINE, 29th St. & PASSYUNK AVE., TO BIGLER STREET.			
Four-track elevated R. R., 29th St. and Passyunk Ave. to Magazine Lane, thence embankment to Broad St. including Broad St. and approaches.	3/10 cost	3/10 cost	2/5 cost
Four-tracks at grade from east side of Broad St. to Bigler St. and Delaware Ave.	3/10 cost	3/10 cost	2/5 cost
Connecting Atlantic Refining Co.'s City's Pt. Breeze Gas Works' sidings and tracks to elevated joint line.	3/10 cost	3/10 cost	2/5 cost
BALTIMORE & OHIO RAILROAD.			
Two-track R. R. on embankment from Vare Ave. to Passyunk Ave.	.....	$\frac{1}{2}$ cost	$\frac{1}{2}$ cost
Two tracks on Delaware from Bigler St. to Vandalia St., .....	.....	$\frac{1}{2}$ cost	$\frac{1}{2}$ cost
New terminal yards between Broad St. and the Delaware River,	.....	entire cost	.....
Purchase by City of piers, tracks, etc., Delaware Ave. to pier head line and McKean to Jackson Sts.	.....	.....	entire cost

The right-of-way for that portion of the joint railroad from 29th Street and Magazine Lane to Delaware Avenue and Hoyt Street, is to be of sufficient width to fully provide for 6 running tracks, 2 of which, with the necessary right-of-way, shall be owned by the Pennsylvania Companies, 2 by the Baltimore Companies and 2 by the Belt Line Company.

The cost of acquiring the said right-of-way is to be apportioned as follows:—60 per cent. by the City, 20 per cent. by the Pennsylvania Companies and 20 per cent. by the Baltimore Companies.

Between Magazine Lane and Passayunk Avenue the cost is to be borne, 2-5 by the city and 3-5 by the two railroad companies.

What is popularly known as the (Belt Line) principal, established by the City of Philadelphia, recognizes for its most general public application, that all railroads now or hereafter entering the city should have free access on equal terms to all public and private wharves on the Delaware River.

Hence, to carry out this policy, the railroad companies and the city agree that the joint railroad between Passyunk Avenue and Queen Street shall constitute an open gate-way for traffic of all railroads to the proposed new municipal docks and the present and future commercial and industrial developments in South Philadelphia.

To make this effective, after the construction and commencement of operation of said joint railroad, any standard gauge railroad company shall have the right to use the same upon certain terms and limitations, and among others, in the matter of compensation, as follows:

It must pay as rental a proportionate share—

First, of the total operating, maintenance and renewal expenses;

Second, 1-3 of the interest upon the total actual cost of the joint railroad to the owning companies.

The estimated cost of the entire project comprised within the terms of the said agreement and to be completed within five years from the date of said agreement, is \$23,000,000.

9.—*Payments.*

The city and the railroad companies are to keep true itemized accounts of the various payments and disbursements made by each upon all obligations, whether assumed by contract or otherwise, authorized by the agreement. Settlement between the city and said companies shall be made monthly as the work shall progress, for any balance that may be due and payable to either of the parties to the agreement

IV. DISCUSSION AND CONCLUSION.

DISCUSSION.

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IV. DISCUSSION AND CONCLUSION.

DISCUSSION.

1.—*The Commonwealth's Responsibility.*

The State of Pennsylvania has shown in the years that have passed, by its contributions to the maintenance and expansion of its only sea-port, a sense of obligation to supply funds, when urgently needed, with which to carry out Port and Harbor projects. These funds have been the principal means by which certain works were financed.

It has been readily admitted that without this aid from the Commonwealth, there must inevitably have been serious interruptions in the activities of the City Department, and some of the most urgently needed repairs and improvements would have been indefinitely postponed for the lack of funds.

As hereinbefore appearing, comprehensive plans for the development of the Port have been worked out by the Department of Wharves, Docks and Ferries, and they commend themselves to those capable of forming reliable judgment thereon. A prompt execution of the plans has been shown hereinbefore to be now needed. To this end, money in considerable quantities must be forthcoming.

It will not do to continue construction operations on a modest scale. Additional and more ample funds are needed. Philadelphians naturally feel that now when the project of greatest magnitude is up, when the present juncture in Port affairs is critical, if the important opportunity for Port expansion is to be embraced, the Commonwealth should in equity, justice and real economy, appropriate a significant and pertinent adequate sum to this public use.

Considering the fact that Philadelphia is the only sea-port of consequence located in the State, and that one-third of the State's population lives within the Philadelphia District and benefits directly from the City's property, and that the entire population of the State is indirectly benefited, it is easily understood why the citizens of Philadelphia insist that liberal help should be extended to the City in its great task of Harbor improvement.

Director Norris said in his 1912 report, touching this point:—

"More than one-fifth of all the people in Pennsylvania live in Philadelphia, and it is a conservative estimate that considerably more than one-third of the Commonwealth's population conduct their business, wholly or in part, in, with or through the city, or by means of the facilities it offers for business and commerce."

"When these facts are taken into account, together with the even more important consideration that Philadelphia contributes in the same ratio to the support of the State Constabulary, the fire wardens employed to prevent forest devastation, for good country roads and many other items of heavy expense, from which it gains only a remote, indirect benefit, it seems difficult, even impossible, to conceive a logical argument that can be advanced as excuse for the State avoiding its fair share of the burdens and responsibilities attached to port development."

2.—*Port's Business Prospects.*

It is not a matter of sentiment that many lines now doing business in New York City would willingly make arrangements with other nearby ports, like Boston, Baltimore or Philadelphia, were suitable accommodations offered them. It is a fact that the pier facilities in New York are unsatisfactory.

Furthermore, as shown hereinbefore, a large amount of new business will inevitably result from the opening of the Panama Canal. And besides, a tremendous amount of marine commerce, resulting from the natural world trade conditions, is seeking new accommodations and a place of permanent attachment. Director Norris says: "Absolutely no sentiment is attached to the distribution of the favors resulting from this trade. If natural and artificial advantages are sufficient, if freight rates are favorable, and suitable wharfage accommodations can be had, one port is absolutely as good as another in the eyes of the practical steamship manager. Philadelphia has the natural advantages, she enjoys a substantial preferential railroad freight rate over most of her rival ports, and her citizens need only a little understanding of the situation and sufficient energy to take advantage of it, to reap a large reward in the growth of her over-sea and coastwise trade."

3—*Future Additional Facilities.*

a—A DEEPER SHIP CHANNEL TO THE SEA.

The completion of the 35 foot channel, now under way, will give Philadelphia ample water for all practical needs for some years to come. Monster ships of the "Titanic" and "Imperator" types are considered mainly as marine freaks, and their use is not likely to extend to other American ports outside of New York. Their introduction has had no effect, and probably will not have any, on freight rates. They have not added to the safety of sea travel, and there appears to be little reason why governments should spend tens of millions of dollars mainly for the purpose of gratifying the pride of rival steamship corporations which desire to advertise their ownership of the largest, or swiftest, or most ornate ship afloat. What Philadelphia wants is freight, and not passengers, except as a purely secondary consideration, and the type of ship desirable to encourage, mainly, is the freighter of the 10,000 to 15,000 tons capacity, or the combination type of freight and passenger ship, with a capacity of 1,000 to 1,500 passengers and 6,000 to 10,000 tons cargo, for which ship—and much larger—the 35 foot channel is sufficient. Boston now has a 40 foot channel under way, however, and Baltimore is talking of one, so that, in self defense, Philadelphia may have to demand the same depth after the completion of the present 35 foot project, which still has from 3 to 6 years' work remaining to be done on it.

b—DRY DOCKS.

The local accommodations in the line of dry and floating docks and marine railways are quite extensive.

The Port has need of a larger dry-dock than any at present constructed. It should be 1200 feet long, to accommodate ocean steamers of the largest modern type.

PRESENT DRY AND FLOATING DOCKS.

Owner.	Kind of.	Length, feet.	Breadth at entrance.	Depth at mean high-water.
Kensington Shipyard Co.,	Dry	432 top 412 bottom	70 ft.	20 ft.
Phila. Navy Yard,	Dry	501 top 419 bottom	89 ft.	25.5 ft.
Phila. Navy Yard,	Dry	739 top 707 bottom	104 ft.	30.0 ft.
Phila. Ship Repair Co.,	Floating	185	85 ft.	16 ft.
Phila. Ship Repair Co.,	Floating	250	86 ft.	17 ft.
Noecker & Ake, Camden,	Floating	230	82 ft.	12 ft.

PRESENT MARINE RAILWAYS.

Name.	Length, feet.	Length of cradle, feet.	Draft on Keel Blocks M. H. W.		Lifting power, tons.
			Forward.	Aft.	
Kensington Shipyard Co.,	600	240	7.5	20	1,000
Kensington Shipyard Co.,	540	288	13	17	2,500
Camden Shipbuilding Co.,	450	350	11.5	15.5	1,500
Quigley & Dorp, Camden,	210	200	9.5	15.5	1,200
Mathis & Co., Camden,	200	175	10	15.5	1,200
Mathis & Co., Camden,	200	150	7	12	800

4.—*The State Control of Canal Construction in the Pittsburgh District.*

Considerations of public welfare have dictated that the State shall assume more direct control of certain phases of economic development, and hence the Public Service Company Law was enacted in 1913.

Furthermore, and inasmuch as Pennsylvania's investments in the iron and steel industry lead the country naturally pointing to the conclusion that the entire state is concerned in the delivery of iron ore to the great steel centers at the lowest possible cost, and because while the railroad systems are excellent, the most important point where the transportation system needs strengthening is the length between Lake Erie and the Ohio River, where approximately 50,000,000 tons of ore and fuel move annually between the Lake and Pittsburgh District, the Legislature of 1913 passed a bill providing for the construction, operation and maintenance by the Commonwealth of a deep canal between these two points.

Now, this canal will surely necessitate great changes and improvements in the water terminal facilities of the railroads in the Pittsburgh District, and there will arise many matters between the railroads, shipping interests, municipalities and the said Public Service Commission, that will require adjustment. Pro-rating, through bills of lading by water and rail, reasonable terminal changes, physical connections between railroads, wharves and ware-houses are some of them.

It may be said with force, that the great steel centers in the Lehigh and Susquehanna Valleys are also vitally interested in cheap ore transportation. Anything done by the State to improve the port of Philadelphia is towards this end. The improvement of economic conditions in Philadelphia and Pittsburgh is a matter for Federal, State and City co-operation.

5.—*Federal Appropriations.*

It would seem, in reviewing the custom receipts of the Port for the last decade, which averages about \$20,000,000 per annum, that the Federal government might with justice and equity speed up the work of channel and harbor improvement. In tonnage of exports and imports Philadelphia ranks second among the Atlantic and Gulf Ports. The total expenditures to date by the Federal, State and City governments in improving and maintaining the Harbor of Philadelphia amounts to only \$17,113,753.

Again, the total expenditures to date by the Federal Government on the Harbor and Delaware River amount to \$19,768,880.55 only. Of this sum the cost to the United States Government of improving the Delaware River, from Philadelphia to the sea was \$15,000,000 in round numbers.

So it appears that the Nation receives each year in cash from Philadelphia port business more than the sum total of all expenditures made by the Nation on the Delaware River and Philadelphia Harbor improvement during three quarters of a century ending June 30th, 1914. At least \$500,000 per annum is needed for United States Government maintenance of the existing 30 foot channel and \$2,500,000 per annum for dredging the 35 foot channel, if the 35 foot channel is to be completed within a reasonable time. Director Norris says that no saving can be effected by doling out money for it in a spirit of miserly, mistaken economy, and the work drag out in consequence for an inordinate number of years as was the 30 foot channel work, as under these circumstances it will be a source of credit and satisfaction to no one, and of expense and chagrin to everybody interested in the commerce of the Delaware River.

6.—*Jurisdiction of the Public Service Commission of the Commonwealth of Pennsylvania.*

George W. Norris, Director of the City Department of Wharves, Docks and Ferries, in his annual report for 1912 has laid down the requirements that a first-class port of the present day must have, and they are stated to be as follows:

First:—At least a 30-foot and preferably a 35-foot channel to the Sea.

Second:—Adequate wharfage and mooring facilities.

Third:—Mechanical appliances for the prompt and economical loading and unloading of cargo.

Fourth:—Suitable storage or warehouse provision.

Fifth:—Facilities for the prompt interchange of business on equal terms between all docks and all railroads entering the city.

Sixth:—Any modern port expecting to develop along rational business lines must be in charge of an administration organization adequately empowered to undertake and efficiently organize the complete activities of the port—its docks, piers, warehouses, anchorages, water-front streets and its Belt Line and other allied railroad tracks and yards.

It would seem that this centralization of city administrative power was in line with the most enlightened modern port-development ideas, and some guarantee of this kind might well be required by the Commonwealth in shape of legislation, as precedent to the granting of any large sum of money to the port by the State.

The Public Service Company Law now provides state jurisdiction over many of the interests herein before enumerated and discussed. Express, ferry, baggage transfer, common carriers, railroads and street railways, telephone and telegraph, wharf, refrigerator and grain elevator companies, including individuals, partnerships or associations engaged for profit in such business, are defined by State law regulating their incorporation, duties, liabilities and limiting their power and are subject to regulation by the Commission established therefor.

With respect to service this regulation touches any and all acts done in the performance of duty to the public and the interchange of facilities between two or more companies. And with respect to facilities it includes all plant and equipment, real property, such as cars of all kinds, locomotives, rolling stock, taxicabs, and vehicles of all descriptions, wharves, docks and ferries, tracks, switches, stations, depots, terminals and terminal facilities and ships, vessels, barges, machinery, appliances, apparatus, etc.

The Commission has power to order extensive repairs, alterations and improvements in service or facilities as shall be reasonable adequate and necessary for the accommodation of the public. Switch connections, continuous transportation, transfers, through routing, construction of crossings, capitalization, rates for service, valuation and certificates, are all matters imposed by law on the Commission to administer on petition, complaint, or on its own initiative.

Of course the docks, and warehouses, and passage-ways, streets, railroads, trolley, transfer and baggage lines, and the other necessary facilities for a modern Port are each only a part of an enormous clearing house for the convenience of shippers and the public. This plant, if one choose to so look at it, (and it is none the less a plant though it be composed of so many diversified parts) should be highly organized and centrally operated for the prompt receipt, classification and economical distribution of goods. Presumably the law makers never intended the Commission to go so far as to assume the general management of the said co-ordination of freight movement to and from steamers, cars and trucks. But the Commission is empowered to keep in touch with such matters, and to the Commission the state administration would naturally look for information more especially if large State appropriations for the Port development were contemplated.

CONCLUSION.

1.—*Estimated Costs.*

For the completion of the elevation and relocation of railroad tracks and freight terminals in South Philadelphia, in conformity with the agreement between the railroads and the city of Philadelphia as approved by The Public Service Commission, it will take about \$25,000,000. It is to be understood that this work is begun and must be completed before any part of it is of use. In other words, the job is one piece of work, in the great plan of Port development. The division of the costs is as follows:

City of Philadelphia's share,	\$10,940,120	
Railroads Companies' shares:		
Penna. Companies,	\$10,527,190	
B. & O. Company,	3,093,790	13,620,980
		<hr/>
		\$24,561,100
		<hr/>

The City's share, equal to \$10,940,120, is divided as follows:

\$7,640,120 to the Department of Public Works, and

\$3,300,000 to the Department of Wharves, Docks and Ferries.

The latter sum is for the purchase by the city of Delaware River water front property vacated by the railroads, which purchase is made mandatory under the terms of the said agreement.

In addition to the work called for by this estimate of twenty-five million dollars, there will be street developments for the improvement of landing facilities, and to supply transportation to and from the pier development, the cost of which has not been estimated inasmuch as the work will cover a long period of years and will not be undertaken in bulk; but it is probable that this will be double the sum given in the above estimate.

It will cost \$10,000,000 of Federal work to finish the 35 foot channel to the sea, and later will follow a 40 foot channel with respect to which no estimate of cost is offered.

Neither is the estimated cost of dredging between the pierhead line and the Federal channel in the Harbor, available at this time. The work will be done gradually as the Pier and Dock facilities are developed.

And there remains the purchase of water front properties whose price is high, and the construction of docks, piers and bulkheads. This work will run into many millions of dollars. So it is seen that \$100,000,000 will have been expended and more, before the Port plans as now conceived in their entirety will have been completed.

2—*Expectations Regarding State Aid.*

Naturally the city has considered various plans of procedure in connection with consummating the projected improvements. The following correspondence is relevant to this matter.

THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA.

BUREAU OF ENGINEERING.

Harrisburg, Pa., June 15, 1914.

Mr. George W. Norris, Director,

Department of Wharves, Docks and Ferries,

Dear Sir:—

Bourse Building, Philadelphia, Pa.

The State of Pennsylvania from early date recognized its responsibility in maintaining responsible supervision of the developments of the Port of Philadelphia, even to the extent of making appropriations therefor; and the General Assembly of the Session of 1913, on the eve of the execution of extended projected improvements of the Port, made an appropriation of \$1,000,000, which was reduced by the Governor to \$250,000. Great disappointment was felt over this action in the city of Philadelphia. There is a definite purpose on the part of the said city to renew its request of the Legislature of 1915, and of succeeding Legislatures to adopt a liberal policy towards the Port developments. I would be very glad indeed to have you inform me about what sum of money is necessary to be spent within the next few years to carry out the plans for Port developments projected by your Department, and also what principal items make up this sum of money. Furthermore, I should like to know what in your opinion would be considered a liberal policy on the part of the Commonwealth in contributing towards this sum, and how you think it should be allotted from time to time.

In this connection, it would be helpful if you would outline what the city is doing to obtain more money by the exercise of its own authority in making appropriations. I understand that the proposed constitutional amendment increasing the borrowing capacity from 7 per cent. to 10 per cent. is one manner and also that the personal property tax revenue may afford an additional source of money which may be diverted to municipal purposes.

To put it differently, the moneys to defray the cost of Port developments come from three sources,—the Federal Government, the State Government and the City Government. By knowing approximately the cost of completing the projected improvements, and what the Federal Government is expected to appropriate, and by being informed as to what you think the State and City should each do towards carrying forward the Port improvements, I can lay before The Public Service Commission, with the data already at hand, a comprehensive report which will serve as a useful reference in case the Administration were to call upon the Commission for advice, at any time, on the subject.

Yours very truly,

F. HERBERT SNOW,
Chief, Bureau of Engineering.

DEPARTMENT OF WHARVES, DOCKS AND FERRIES.

Mr. F. Herbert Snow,
 Chief, Bureau of Engineering,
 Public Service Commission,
 Harrisburg, Penna.

Philadelphia, June 17, 1914.

Dear Sir:—

I am in receipt of your favor of the 15th inst. As you say, the cost of improvements at this Port is necessarily divided between the Federal Government, the State Government and the City. The Federal Government confines itself to the deepening and the maintenance of the channel in the Delaware River, assuming no responsibility for the depth of water anywhere in the river outside of the channel, nor any responsibility at all for dredging work in either the Schuylkill River or Frankford Creek. The City owns and operates a dredging plant, the practical capacity of which is limited to about 700,000 cubic yards a year. The primary purpose of this plant is to preserve a proper depth of water in docks, but we have also been able to do considerable work in improving the channel of the Schuylkill River. The Federal Government has given us a clear 30-ft. channel to the sea, and has about two-fifths completed the dredging of this channel to 35 feet. The Federal expenditures to date have been over \$15,000,000, and the cost of completing the 35-ft. channel will be at least \$10,000,000 additional. The City has borne the whole expense of acquiring and maintaining the municipal dredging plant except for assistance to the extent of about \$80,000 from the State appropriation of 1911. The City has also spent over \$10,000,000 in the widening of Delaware Avenue, in the acquisition of sites and construction of piers, and in co-operating with the Federal Government in the removal of Smith's and Windmill islands. The State appropriations to date have been about \$1,350,000.

The work of developing this Harbor is necessarily expensive, not only because of the inevitable large cost of constructing piers suitable for large deep-draft modern vessels carrying thousands of tons of cargo, but also because of the fact that the State having allowed the water-front to pass into private ownership, there is always the added cost of acquiring a site.

It is difficult to advise you as to what sum of money is to be spent within the next few years, because the amount of work to be done is influenced not only by the amount of money available but by the present and future demands of commerce. To a large degree it is necessary to anticipate those demands, but good judgment dictates that the development of facilities should not get too far ahead of the demands for their use. Answering your question in a general way, I would say that an expenditure of something like \$20,000,000 on pier construction and co-ordinate improvements would develop this Port to a sufficient extent to enable it to take care of all the business that is likely to come to it in the next twenty years. The adoption of the Constitutional Amendment provided for in a Resolution introduced at the last Legislature, authorizing the City to increase its borrowing capacity from 7 per cent. to 10 per cent. of the assessed value of taxable property for transit and Port improvements, would leave nearly or quite \$20,000,000 available for the latter class of improvements. The Port of Philadelphia, however, is also the Port of Pennsylvania—its only available gate-way to the sea—and the improvement of the Port is, therefore, not merely a matter of local interest, but a matter which very vitally affects the interest of shippers throughout the State who are at present put to the cost and inconvenience of handling shipments through other ports, with re-handling of goods and heavy lighterage and other Port charges. Moreover, it is eminently proper and fair that the State should bear the cost of whatever dredging work is necessary outside of the channel which is taken care of by the Federal Government, and the docks which are taken care of by the City. It would, therefore, seem to me that if the Legislature were to adopt the policy of making a biennial appropriation of \$1,000,000 it would be doing no more than its share, and that such action would be of distinct advantage to shippers throughout the State, and would be an encouragement to both the Federal and Local authorities to continue their policy of generous appropriations.

Trusting that this generally answers your inquiries, and assuring you of the continued co-operation of the Department, I am,

Very truly yours,

GEO. W. NORRIS, *Director.*

The Bureau of Engineering

OF

THE PUBLIC SERVICE COMMISSION

OF THE

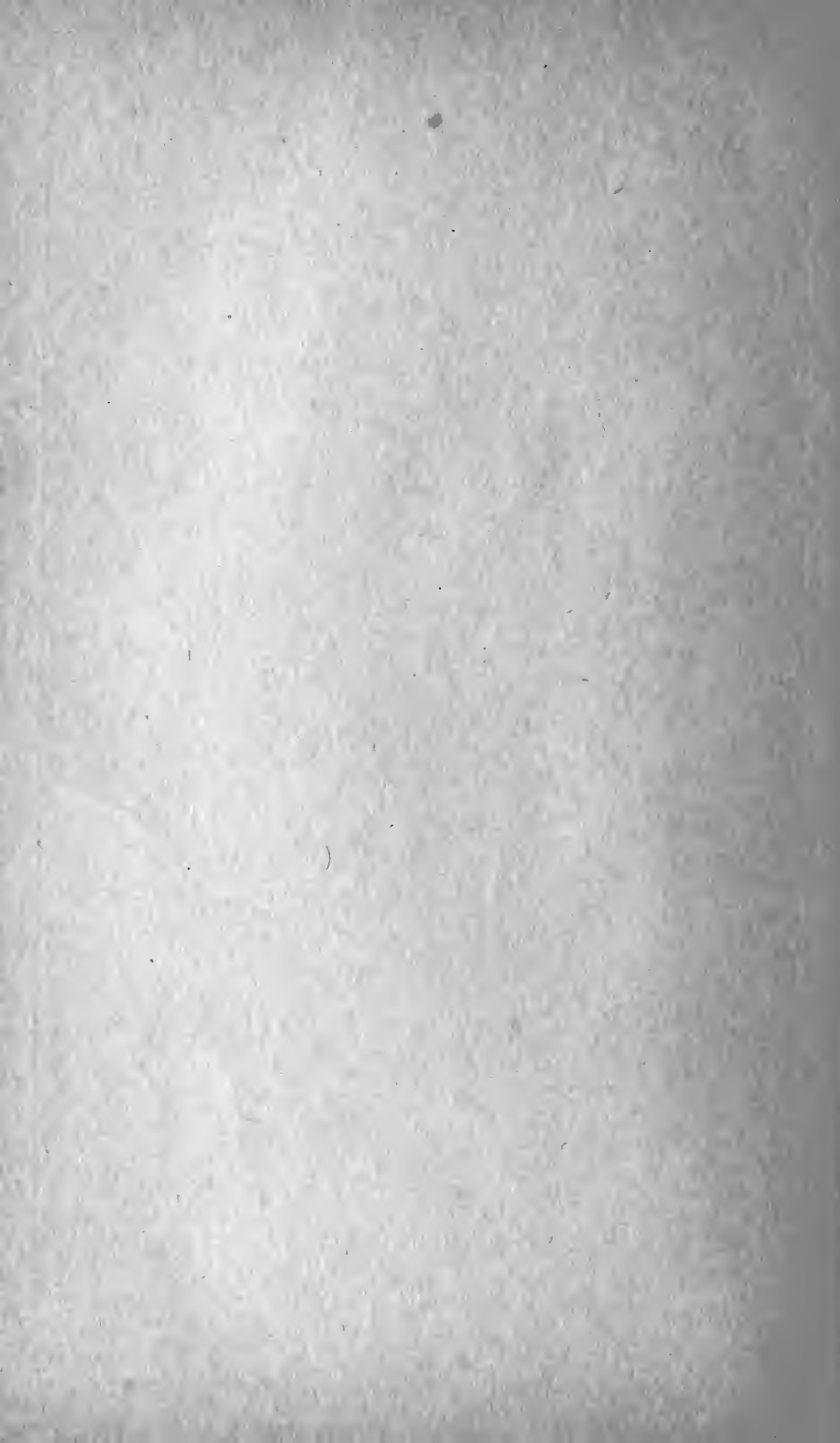
COMMONWEALTH OF PENNSYLVANIA

SECOND ANNUAL REPORT

For the Year Ending June 30th, 1915

F. HERBERT SNOW, C. E., Chief

HARRISBURG, PA.:
WM. STANLEY RAY, STATE PRINTER
1917.



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PART II. ADMINISTRATION AND SPECIAL WORK IN CONNECTION
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RATORIES.

PART III. INVESTIGATION OF FORMAL AND INFORMAL COMPLAINTS.

PART IV. INVESTIGATION OF HIGHWAY CROSSING APPLICATIONS.

PART V. SPECIFICATIONS COVERING CONSTRUCTION OF CROSS-
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LETTER OF TRANSMITTAL

Harrisburg, Pa., June 30th, 1915.

To the Public Service Commission of the Commonwealth of Pennsylvania, Mr. Archibald B. Millar, *Secretary*.

Dear Sir—I have the honor to submit the Second Annual Report of the Bureau of Engineering.

Under Part I—Organization and Administration—an account is given of the Bureau staff employed during the year, the location of the offices and laboratories, and the general and special activities of the Bureau for the year.

Part II of the report deals with the administrative and special work of the Bureau in connection with service rules and standardization laboratories.

Part III deals with the investigation of formal and informal complaints.

Part IV deals with the investigation of highway crossing applications.

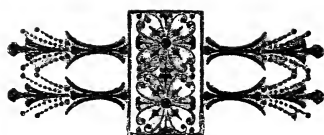
Part V deals with specifications covering construction of crossings of overhead lines of public utilities.

Part VI deals with uniform service rules for water companies.

Part VII deals with reports of special interest such as the elimination of grade crossing problems, certificates of valuation, certificates of notification, valuations for rate making, and minimum meter rates.

All of which is respectfully submitted,

F. HERBERT SNOW,
Chief, Bureau of Engineering.



PART ONE

ORGANIZATION AND ADMINISTRATION.

BUREAU STAFF

The following is a report of the operations of the Bureau of Engineering for the fiscal year ending June 30th, 1915, and forms the Second Annual Report made by the Bureau.

The writer has continued to serve during the year in the capacity of "Chief of the Bureau of Engineering" of the Public Service Commission.

Mr. Charles P. Swope was appointed Chief Clerk of the Bureau on August 11th, 1914, and continued to serve in this capacity throughout the year.

Mr. Percy Schmertz was appointed Electrical Standards Tester on August 11th, 1914, but did not accept the position. On October 22nd, 1914, Mr. Horace B. Pratt was appointed to the position and has discharged the duties of the office throughout the year.

Professor R. H. Fernald of the University of Pennsylvania, continued with the Bureau in the capacity of Consulting Mechanical Engineer and Professor L. H. Harris of the University of Pittsburgh continued throughout the year in the capacity of Consulting Electrical Engineer for the Bureau.

During the summer Professor Harris visited and made examinations of a number of electric utilities throughout the State with particular reference to the requirements of the Service Rules adopted by the Commission. A detailed account of this work is given in Part II of this report.

During the summer Professor H. E. Ehlers of the University of Pennsylvania was engaged in a similar investigation of water and gas utilities and a detailed report of the results of this work will be found in Part II of this report.

On January 27th, 1915, Mr. Ehlers was appointed to the position of Assistant Chief of this Bureau and during the remainder of the year discharged the duties of this position.

Upon the resignation of Mr. John B. F. Laurie, Draftsman of the Bureau on December 1st, 1914, Mr. H. D. Buckwalter, C. E., was appointed to the position of Assistant Engineer, his appointment dating from December 1st, 1914. Mr. Buckwalter came to the Bureau from the Bridge Division of the State Highway Department.

Miss M. Irene Cuenot, continued to serve throughout the year as Chief Stenographer. Miss Nora L. Myers was appointed stenographer on December 15th, 1914; Miss Helen C. Farmer was appointed stenographer on December 8th, 1914; and Mrs. L. A. Yon was appointed stenographer on January 22nd, 1915.

Mr. Harry R. Branyan was appointed draftsman in the Bureau on January 27th, 1915.

On April 9th, 1915, Mr. Beverley R. Mayer, C. E., was appointed Assistant Engineer and was assigned to special work at Scranton in connection with the problem of the improved transportation facilities and a Union Station.

Mr. Addison C. Gumbert resigned his position as Meter Prover Tester effective June 30th, 1915, and the position was filled by the appointment of Mr. J. Ed. Boyle of Beaver Falls.

Special work for the Bureau was performed by Engineers employed for the purpose and with duties limited to the particular employment as follows:

Mr. H. F. Bronson of the State Water Supply Commission made an investigation of the complaint filed by the Minnequa Furniture Company against the Citizens Water Company of Canton Borough in December, 1914, and filed a report with the Bureau giving the results of his investigation.

Mr. Richard H. Brodhead, C. E., of Greenville, Mercer County, was employed during January, 1915, to make a physical valuation of the properties of the Titusville Traction Company.

Mr. Frank H. Hoffman was employed to make an investigation of the complaint of George W. Aubrey against the Egypt Light, Heat and Power Company, the complaint alleging that the service meter in use was incorrect.

In May, 1915, a contract was made with Mr. Morris Knowles of Pittsburgh, to assist the Bureau in making an inventory and an appraisal of the properties of the Springfield Consolidated Water Company for use in the rate case before the Commission. The contract was made with Mr. Knowles as a result of the small staff of the Bureau at this time and because of Mr. Knowles' familiarity with the situation. At a prior time Mr. Knowles had made an inventory and an appraisal of a considerable portion of the properties on behalf of certain citizens, some of whom are petitioners in the pending case.

Messrs. W. H. Hornbaker, C. F. Germeyer, and M. B. Brown, were

employed upon an hour basis at various times to help out in the grafting room on special work assigned to the Bureau.

At the end of the year the regular staff of the Bureau was constituted as follows:

F. Herbert Snow,	Chief of Bureau.
H. E. Ehlers,	Assistant Chief of Bureau.
R. H. Fernald,	Consulting Mechanical Engineer.
L. H. Harris,	Consulting Electrical Engineer.
Charles P. Swope,	Chief Clerk.
Miss M. I. Cuenot,	Chief Stenographer.
Miss Helen C. Farmer,	Stenographer.
Miss Nora L. Myers,	Stenographer.
Mrs. Laura A. Yon,	Stenographer.
H. D. Buckwalter,	Assistant Engineer of Bridges
B. R. Mayer,	Assistant Engineer of Railroads.
Mr. H. R. Branyan,	Draftsman.
Mr. J. Ed. Boyle,	Meter Prover Tester.
Mr. H. B. Pratt,	Electrical Standards Tester.

OFFICES AND LABORATORIES.

During the first half of the fiscal year the Bureau continued to occupy Room 327, adjoining the other rooms used by the Commission. These quarters were proving inadequate and furthermore, were needed for general offices by the Commission and on January 19th, 1915, the Engineering Bureau moved into its new quarters at 129 N. 4th Street, this building having been purchased by the State and fitted for occupancy by the Bureau by the State Department of Public Grounds and Buildings.

By the courtesy of the University of Pittsburgh laboratory facilities were provided by that institution for carrying on the work of electrical standards testing and a detailed discussion of this work is given in Part II of this report. Following the decision of the Commission to establish its own laboratories in Harrisburg, the Board of Public Grounds and Buildings assigned a portion of the Day School Building to the Bureau for this purpose and proceeded to make the necessary alterations and improvements. Orders were placed for laboratory apparatus and equipment necessary to establish gas, water, and electrical standardization laboratories, as set forth in detail in Part II of this report.

GENERAL ACTIVITIES OF THE BUREAU.

Reports to the Commission.

During the fiscal year ending June 30th, 1915, the Engineering Bureau submitted 154 reports to the Commission upon matters assigned to the Bureau for investigation, in addition to the monthly reports made to the Commission in the matter of the work and activities of the Bureau. The following classification of these reports will prove of interest:

- 23 Related to the service and facilities given by utilities.
- 17 Related to valuation and related problems.
- 90 Related to highway crossings.
- 11 Related to wire crossings.
- 5 Related to Bureau and Commission matters.
- 8 Related to Miscellaneous matters.

Total 154

Administration of Service Rules.

Due to lack of staff and lack of facilities the work of the Bureau in connection with the administration of the Service Rules adopted by the Commission was limited to the testing of gas meter provers in the field and the testing of electrical standards in the laboratories of the University of Pittsburgh.

The electrical standardization work was done by Mr. Pratt, under the direction of Professor L. H. Harris. During the fiscal years ending June 30th, 1915, 153 separate standards were submitted for test, 34 were certified as received, 115 were certified following minor adjustments and 18 were received in a condition too poor to warrant testing or else were of an unsuitable type.

The testing of gas meter provers was carried on in the field by Mr. A. C. Gumbert under the direction of Mr. Ehlers. During the fiscal year 97 meter shops were visited and 119 provers were bottled. Twenty-eight provers were rejected because of poor facilities or poor condition, 30 provers were rejected on the first test because of inaccuracy, 63 provers were certified as accurate within the limits specified by the Commission on the first test, and 18 provers were certified as a result of subsequent tests.

A detailed description of the development and of the results of the above work will be found Part II of this report.

Investigation of Formal and Informal Complaints.

During the fiscal year the Bureau made investigations and submitted reports to the Commission of the matters complained of in 33 Informal Complaints and 26 Formal Complaints that had been

referred to the Bureau for this purpose. These complaints had to do with the service or facilities or the rates of water, gas and electric utilities, trolley companies, railroads, and telephone companies. A more detailed discussion of this work will be found in Part III of this report.

In connection with this work and particularly in connection with valuation and rate cases, the Bureau has developed a system of engineering conferences for the purpose of saving the time of the Commission and expediting the work. At these engineering conferences, made up of engineers representing the parties in interest before the Commission and presided over by an engineer representing the Commission, questions of inventory and appraisal are discussed item by item and if possible agreed to, and if agreement is not possible the differences are noted and called to the attention of the Commission or else are left open for the presentation of testimony at the hearings. The results of these conferences are presented to the Commission in the form of a signed report enumerating in detail the items concerning which an agreement has been reached, the items the conference desires to call to the particular attention of the Commission and any stipulations or conditions relating thereto. This procedure has been found to reduce very materially the amount of testimony offered at the hearings with a consequent reduction in the volume of testimony and exhibits to be considered by the Commission and with a consequent reduction in the time required for hearings.

Highway Crossing Applications.

During the fiscal year the Engineering Bureau investigated and reported upon 130 crossings of highways by railroads or railways. These investigations were made as a result of applications or complaints filed with the Commission relative to the construction or modification of railroad crossings at, above, or below grade. The applications for 27 of these crossings proposed to eliminate dangerous existing grade crossings by either a separation of grades or an abandonment of the highway; applications for 77 main line crossings proposed to establish 61 of these at grade, 4 below the grade of the highway and 12 above the grade of the highway; applications for 22 industrial siding crossings proposed to establish 20 of these at grade, and 2 above the grade of the highway. Detailed statistics and a description of this work will be found in Part IV of this report.

SPECIAL ACTIVITIES OF THE BUREAU.

Survey of Gas, Water, Electric and Heating Utilities.

Following the adoption of service rules by the Commission in the Spring of 1914, it was decided by the Commission that the general information obtained as a result of a survey of conditions in the

various utilities with particular reference to items of interest in connection with the Rules and Regulations adopted by the Commission would aid materially in the development of this phase of the Commission's activities.

Accordingly the Commission engaged the services for the summer of Professors L. H. Harris and H. E. Ehlers for this purpose. The scope of the electric survey was planned to embrace all companies operating in towns of over 10,000 population. The scope of the gas survey was planned to cover all gas utilities whose output exceeded 20,000,000 cubic feet per year. At the same time inspecting as many water and heating utilities as time and circumstances would permit.

During the summer inspections were made of 48 electric utilities, 27 artificial gas utilities, 18 natural gas utilities, 18 water utilities and 8 heating utilities. The general reports submitted together with a discussion of the work will be found in Part II of this report.

Appointment of Joint Engineering Committees.

With the consent of the Commission the Chief of the Engineering Bureau secured the appointment of standing committees by the various utility associations in the State. These committees were appointed for the purpose of co-operating with the Commission in matters of mutual and of general interest. Examples of the work of these committees are the "Specifications covering the Construction at Crossings of Overhead Lines of Public Utilities" hereinafter discussed and the "Uniform Service Rules" prepared by the Committee of the Pennsylvania Water Works Association and submitted to the Commission for its consideration. These matters are set forth in detail in Parts V and VI of this report.

Joint Committees were appointed by the following State organizations:

The Pennsylvania Electric Association.

The Pennsylvania Street Railway Association.

The Pennsylvania Gas Association.

The Pennsylvania Water Works Association.

Overhead Wire Crossing Specifications.

The Public Service Company Law imposes upon the Commission the duty of regulating the matter of the crossing of the facilities of one public service company by those of another. The Commission undertook to regulate these matters in the form of an Order issued under date of January 8th, 1914, as "General Order No. 2". It was later determined that the provisions of General Order No. 2 were not in strict conformity with the Law and on August 5th, 1914, the Commission issued "General Order No. 11" superseding General Order No. 2.

A brief experience under this Order soon showed that the Law and the Provisions of the Order created unnecessary burdens and furthermore, were not bringing about the results desired. The practicability under the Law of establishing a standard specification or a general rule prescribing the terms and conditions under which crossings may be constructed, operated, maintained, and protected without the particular approval of the Commission was thought to be sufficient warrant for a study of the subject. Accordingly the Commission authorized and directed the Chief of the Bureau of Engineering to proceed with such a study and to call into co-operation the various interests in Pennsylvania that would be affected by such an Order.

A general meeting was held in Harrisburg on November 16th, 1914, at which were present representatives of the telephone and telegraph companies, the steam railroads the street railways, the electric light and power companies, and the water and gas companies. These interests were represented by the standing committees of the various State Associations appointed for such purpose. The meeting resulted in the appointment of a sub-committee to study the crossing situation and to prepare a set of specifications for the consideration of the Commission.

The personnel of this sub-committee and the personnel of the general committee together with a more complete discussion of the problem will be found in Part V of this report.

Under date of May 18th, 1915, the sub-committee submitted its report in the form of a printed specification accompanied by a letter of transmittal addressed to the Chief of the Bureau of Engineering. In accordance with the understanding reached at the first general meeting, this report was to be submitted to the general committee for consideration before being presented to the Commission and accordingly a call was issued for a general meeting to be held in Harrisburg on July 20th, 1915. No further action was taken in the matter during the fiscal year ending June 30th, 1915.

The report of the sub-committee and the specifications forming a part of that report will be found in Part V hereinafter.

Suggested Uniform Service Rules.

In connection with the early work of the Commission it soon became apparent that it would be highly desirable to draw up service rules and regulations for water utilities to use in the conduct of their business that would make more for uniformity of action and procedure throughout the State. Accordingly a conference was arranged between the standing committee of the Pennsylvania Water Works Association and the committee of the Pennsylvania Public Service Commission. As a result of this conference a sub-committee was authorized to draw up a set of general rules and regulations to be

presented to the Commission for its consideration. Meetings were held at different times and resulted in the presentation to the Commission under date of May 3rd, 1915, of a proposed set of uniform service rules. The proposed rules and the proceedings leading up to their adoption by the committee are set forth in detail in Part VI of this report. No further action was taken in the matter during the rest of the fiscal year either by the Commission or by its Bureau of Engineering.

PART TWO

ADMINISTRATIVE AND SPECIAL WORK IN CONNECTION WITH SERVICE RULES AND STANDARDIZATION LAB- ORATORIES.

SURVEY OF GAS, WATER, ELECTRIC AND HEATING UTILITIES.

General Purpose of Survey.

Following the adoption of Service Rules by the Commission in the Spring of 1914, it was decided by the Commission that the general information obtained as a result of a survey of conditions in the various utilities with particular reference to items of interest in connection with the Rules and Regulations adopted by the Commission would aid materially in the development of this phase of the Commission's activities.

As set forth in the First Annual Report of the Bureau, the chief purpose of the survey was to examine the standards and testing facilities maintained by the utilities, their use of the same, the nature and adequacy of their records covering the various items specified in the Rules and Regulations of the Commission and to make recommendations to the Commission concerning the approval of any or all of these items. The inspections necessary to obtain the above information would also afford opportunity for placing the Commission and the utilities in closer relation with one another, clarify ideas and concepts for both parties and offer the representatives of the Commission opportunities to be of service to the utilities.

Personnel and Scope of work.

The Commission engaged the services, during the summer months, of Professor L. H. Harris of the University of Pittsburgh, to make the survey of conditions existing in the electrical field and the services of Professor H. E. Ehlers of the University of Pennsylvania, for a similiar period, to make the survey in the field of gas, water, and heating utilities.

The scope of the electric survey was planned to embrace all companies operating in towns of 10,000 population or over. The scope of the gas survey was planned to cover all gas utilities whose output exceeded 20 million cubic feet per year, at the same time inspecting as many water and heating utilities as time and circumstances would permit.

The months of July and August 1914 were devoted to field work and in this time inspections were made as follows:

- 48 electric utilities.
- 27 artificial gas utilities.
- 18 natural gas utilities.
- 18 water utilities.
- 8 heating utilities.

The detailed information obtained is on file in the Bureau on forms described in the First Annual Report. The general reports submitted are given hereinafter.

"Harrisburg, Pa., August 28, 1914.

Mr. F. Herbert Snow, Chief,
Bureau of Engineering,
The Public Service Commission.

Dear Sir:—

I beg to submit herewith my report of the work of inspecting the Electric Utilities during the summer just past.

PURPOSE AND SCOPE OF INSPECTIONS.

The purpose was three-fold:

1st. To investigate the meter testing facilities and practices of the larger and better organized utilities preliminary to approval of such facilities, as required in the Rules.

2nd. To learn wherein the practices of these utilities especially in regard to the keeping of operating records, and the safeguarding of their service, failed to meet in essential character the standards required by the Commission, and

3rd. To meet the managers and superintendents for the purpose of answering questions concerning the rules, of exchanging views, and to advise concerning proper changes and improvements when such advice was requested, as was often the case.

In this work, effort was made to avoid creating in the officials, any feeling of irritation or unwarranted interference on the part of the representative of this Department. No verbal advice was given unless asked for, and no questions were asked, which were not pertinent to the business at hand, unless the circumstances were propitious and the official communicative.

The scope as originally planned embraced all companies operating in towns of 10,000 population and over. The entire territory included in the original plan was covered, but owing to unforeseen and unpreventable circumstances, the inspection of some half dozen companies has been postponed. These delays

were due chiefly to the absence of the necessary officials at the time the inspector was in that locality.

CHARACTER OF REPORTS MADE.

A report was made on each utility visited. These reports generally comprise, 1st. A blank with simple 'yes' and 'no' statements of facts about which information is desired.

2nd. A short sketch giving additional information concerning local conditions, not essential, but nevertheless desirable and obtained whenever and to whatever extent circumstances warranted, and

3rd. Definite recommendations regarding the desired changes in the practices of the utility.

Following is a list of the Electric Light & Power Companies of the State which were visited and on which reports have been made.

Corporate Name.	P. O. Address.	Name and Position of Official.	Approximate meter customers.	Approximate population served.
Lehigh Vy. Ly. & Pr. Co.,	Allentown,	A. H. S. Cantlin, Manager,	11,000	120,000
Bradford E. L. & P. Co.,	Bradford,	L. O. Langworthy,	600	15,000
Beacon Lt. Co.,	Chester,	Jno. Malloy, Supt.,	2,030	39,030
Carlisle L. H. & P. Co.,	Carlisle,	J. M. Hays, Pres.,	2,000	25,000
Chester Vy. E. Co.,	Coatesville,	F. W. Harris, Manager, ..	2,000	25,000
The DuBois El. Co.,	DuBois,	R. G. Blakeslee, Supt., ..	775	17,000
Errie County El. Co.,	Errie,	T. G. O'Dea, Manager, ..	3,300	70,000
Penna. Utilities Co.,	Easton,	R. W. Keiple, Asst. Mgr., ..	800	5,000
Gettysburg Ltg. Co.,	Gettysburg,	T. P. Turner, Manager, ..	850	12,000
Hanover L. H. & P. Co.,	Hanover,	R. E. Manley, Manager, ..	4,000	35,000
The Harwood El. Co.,	Hazleton,	J. S. Wise, Manager, ..	7,400	90,000
Harrisburg L. & P. Co.,	Harrisburg,	G. B. Tripp, Manager, ..	6,000	100,000
Luzerne Co. G. & E. Co.,	Kingston,	A. G. Llewellyn, Supt., ..	5,700	90,000
The Edison El. Co.,	Lancaster,	R. B. Hull, Manager, ..	1,280	15,000
Penn Central L. & P. Co.,	Lewistown,	F. P. Duggan, Supt.,	1,600	26,000
Edison El. Illg. Co.,	Lebanon,	H. G. Louser, Supt.,	1,200	15,000
Peoples Incan. L. Co.,	Meadville,	W. G. Catherman,	2,000	25,000
Edison El. Illg. Co.,	Mt. Carmel,	G. W. Keiser, Manager, ..	4,500	50,000
Schuylkill G. & E. Co.,	Mahanoy City, ..	P. McCarron, Supt.,	2,910	40,000
Edison El. Illg. Co.,	New Castle,	G. C. Chestnut, Supt.,	1,700	40,000
Counties Gas & E. Co.,	Norristown,	H. H. Gausser, Manager, ..	1,000	17,000
Citizens L. & P. Co.,	Oil City,	G. H. McClure, Manager, ..	600	25,000
Citizens El. Illg. Co.,	Pittston,	K. G. Ross, President, ..	44,000	1,000,000
The Duquesne Lt. Co.,	Pittsburgh,	H. N. Mueller, Supt.,	1,200	17,000
Phila. Sub. G. & E. Co.,	Pottstown,	T. S. Spence, Manager, ..	860	2,000
Phila. Sub. G. & E. Co.,	Phoenixville,	G. T. Dempsey, E. E., ..		
Phila. Elec. Co., including the Bais & Marion E. Co., The Beacon Lt. Co., and The Delaware Co. El. Co., Philadelphia,	Philadelphia,	W. H. Johason, Vice-Pres.,	62,700	2,000,000
East. Pa. L. H. & P. Co.,	Pottsville,	J. G. Walborn, Supt.,	5,865	75,000
Jefferson Elec. Co.,	Punxsutawney, ..	W. M. Krise, Mgr.,	500	11,000
Metropolitan El. Co.,	Reading,	H. H. Kaum, Supt.,	5,660	120,000
The Ridgway El. Lt. Co.,	Ridgway,	C. H. Law, Manager,	730	6,000
Beaver Co. Lt. Co.,	Rochester,	S. H. Slear, Act. Mgr., ..		
Scranton Elec. Co.,	Scranton,	D. T. Campbell, Manager, ..	14,258	225,000
The Shenandoah Vy. E. L. Co., The Sharpsville E. L. Co., Northumberland Co. G. & E. Co., Co.,	Sharon,	C. L. Kemery, Supt.,	1,300	30,000
Penna. Ltg. Co.,	Sunbury,	R. G. Regue, E. E.,	3,000	21,000
Phila. Suburban G. & E. Co.,	Shamokin,	G. A. Britton, Manager, ..	2,719	30,000
The Wilkes-Barre Co.,	W. Chester,	R. R. McConnell, Supt., ..	1,250	15,000
Citizens Elec. Co.,	Wilkes-Barre,	F. Kelley, Supt.,	5,000	100,000
Lycoming-Edison Co.,	Williamsport,	M. A. Meyers, Supt.,	1,200	32,000
Waynesboro E. L. & P. Co.,...	Waynesboro,	G. W. Wendle, Asst. Gen. Mgr., ..	4,000	40,000
Warren Lt. & P. Co.,	Warren,	R. D. Sefton, Manager, ..	850	12,000
Edison Lt. & P. Co.,	York,	G. E. Hill, Mgr.,	800	15,000
Merchants E. L. H. & P. Co.,	York,	W. H. Long, Supt.,	4,500	50,000
		G. E. Miller, Supt.,	1,400	45,000

Total number of companies visited,	48
Total population served by companies covered by this work is approximately,	4,814,000
Total number of consumers served by the companies covered by this work is approximately,	223,532

It is estimated that 75 per cent. of all consumers are affected by the inspections thus far made.

Number of municipalities listed in McGraw directory as having electrical service,	470
Number of municipalities served by municipal plants,	40
Number of municipalities listed in McGraw directory which are included in the work covered by this report,	188
Municipalities listed in McGraw directory remaining to be covered,	242
Number of corporations or privately owned companies listed in McGraw directory,	228
Number of companies listed in McGraw directory and affected by work covered in this report,	48
Number of companies listed in McGraw directory and remaining to be covered,	180

LIST OF CITIES, TOWNS AND VILLAGES SERVED BY THE COMPANIES INSPECTED.

Allentown,	Lehigh Vy. Lt. & P. Co.
South Allentown,	See Allentown.
Atglen,	" Lancaster.
Avon,	" Lebanon.
Atlas,	" Mt. Carmel.
Aldan,	" Philadelphia.
Ashland,	" Pottsville.
Adamstown,	" Reading.
Amityville,	" Reading.
Archbald,	" Scranton.
Avoca,	" Scranton.
Ashley,	" Wilkes-Barre.
Amixville,	" York.
Bethlehem,	" Allentown.
South Bethlehem,	" Allentown.
Bath,	" Easton.
Bangor,	" Easton.
Beaver Meadow,	" Hazleton.
Burnham,	" Lewistown.
Bala,	" Philadelphia.
Barmouth,	" Philadelphia.
Black Bear,	" Reading.
Blandon,	" Reading.
Brookside,	" Reading.
Collegeville,	" Norristown.
Catasauqua, ..	" Allentown.
Copley,	" Allentown.
North Catasauqua,	" Allentown.

Carlisle,	Carlisle Lt., Ht. & P. Co.
Coatesville,	Chester Valley Elec. Co.
Conewago,	See Hanover.
Courtdale,	" Kingston.
Columbia,	" Lancaster.
Christiana,	" Lancaster.
Crum Lynne,	" Philadelphia.
Cynwyd,	" Philadelphia.
Colwyn,	" Philadelphia.
Clifton Heights,	" Philadelphia.
Collingdale,	" Philadelphia.
Cardington,	" Philadelphia.
Cressona,	" Pottsville.
Centralia,	" Pottsville.
Carbondale,	" Scranton.
Dauphin,	" Harrisburg.
Downingtown,	" Coatesville.
Dorrancetown,	" Kingston.
Dallas,	" Kingston.
Darby,	" Philadelphia.
Duryea,	" Pottsville.
Dickinson City,	" Scranton.
Dunmore,	" Scranton.
DuBoistown,	" Williamsport.
Dallastown,	" York.
Dover,	" York.
Emaus,	" Allentown.
Easton,	Penn'a Utilities Company.
W. Easton,	See Easton.
Edwardsville,	" Kingston.
Elizabethtown,	" Lancaster.
Exchange,	" Mt. Carmel.
Eddystown,	" Chester.
Easterly,	" Reading.
Folsom,	" Chester.
Freemansburg,	" Allentown.
Fountain Hill,	" Allentown.
Freeland,	" Hazleton.
Forty Fort,	" Kingston.
Folcroft,	" Philadelphia.
Fernwood,	" Philadelphia.
Frackville,	" Pottsville.
Friedensburg,	" Reading.
Frush Valley,	" Reading.
Forest City,	" Scranton.
Gettysburg,	Gettysburg Lighting Co.
Glen Lyon,	See Kingston.
Green Ridge,	" Mt. Carmel.
Glenolden,	" Philadelphia.
Garrettford,	" Philadelphia.
Girardville,	" Pottsville.
Gilberton,	" Pottsville.
Glendon,	" Easton.
Hyde Park,	" Reading.

Hellam,	See York.
Harrisburg,	Harrisburg Lt. & Power Co.
Highspire,	See Harrisburg.
Hanover,	Hanover Lt. & Power Co.
Hebron,	See Lebanon.
Hazleton,	Harwood Electric Company.
W. Hazleton,	See Hazleton.
Jacksonwald,	" Reading.
Jermyn,	" Scranton.
Jessup,	" Scranton.
Kurtzhouse,	" Reading.
Kingston,	Luzerne County G. & E. Co.
Kulpmont,	See Mt. Carmel.
Lansdowne,	" Philadelphia.
Lucknow,	" Harrisburg.
Linglestown,	" Harrisburg.
Lebanon,	Edison Electric Illg. Co.
Lewistown,	Penn Central Lt. & P. Co.
Larkesville,	See Kingston.
Littlestown,	" Hanover.
Luzerne,	" Kingston.
Lancaster,	The Edison Electric Co.
Lititz,	See Lancaster.
Locust Gap,	" Mt. Carmel.
Leiperville,	" Philadelphia.
Linwood,	" Philadelphia.
Loyalsock,	" Williamsport.
Media,	" Philadelphia.
Milton,	" Sunbury.
Mont Claire,	" Phoenixville.
Millmont,	" Reading.
Mt. Carmel,	Edison Elec. Illg. Co.
Mahanoy City,	Schuylkill G. & E. Co.
Modena,	See Coatesville.
McSherrystown,	" Hanover.
McAdoo,	" Hazleton.
Macanagua,	" Kingston.
Marietta,	" Lancaster.
Mt. Joy,	" Lancaster.
Manheim,	" Lancaster.
Mountville,	" Lancaster.
Myerstown,	" Lebanon.
Merion Heights,	" Mt. Carmel.
Marcus Hook,	" Philadelphia.
Merion,	" Philadelphia.
Morton,	" Philadelphia.
Minersville,	" Pottsville.
Mohnton,	" Reading.
Mt. Penn,	" Reading.
Mayfield,	" Scranton.
Moosic,	" Scranton.
Minooka,	" Scranton.
Malvern,	" Philadelphia.
Miners Mills,	" Wilkes-Barre.

Montoursville,	See Williamsport.
Manchester,	" York.
Mt. Wolf,	" York.
Northumberland,	" Sunbury.
Norristown,	Counties Gas & Elec. Co.
Northampton,	See Allentown.
Nazareth,	" Easton.
Nanticoke,	" Kingston.
New Holland,	" Lancaster.
Norfolk,	" Philadelphia.
Narberth,	" Philadelphia.
Norwood,	" Philadelphia.
Oberlin,	" Harrisburg.
Orwigsburg,	" Pottsville.
Overbrook,	" Philadelphia.
Oakwood,	" Reading.
Old Forge,	" Scranton.
Progress,	" Harrisburg.
Penbrook,	" Harrisburg.
Paxtang,	" Harrisburg.
Philadelphia,	Philadelphia Electric Co.
Phoenixville,	Phila. Suburban G. & E. Co.
Pottstown,	Phila. Suburban G. & E. Co.
Pittston,	Citizens Elec. Illg. Co.
Plymouth,	See Kingston.
Pottsville, *	East Penna. Lt., Ht. & P. Co.
Parkesville,	See Coatesville.
Pomeroy,	" Coatesville.
Portland,	" Easton.
Pen Argyl,	" Easton.
Pringle Hill,	" Kingston.
Prospect Park,	" Philadelphia.
Primos,	" Philadelphia.
Port Carbon,	" Pottsville.
Palo Alto,	" Pottsville.
W. Pittston,	" Pittston.
Pleasantville,	" Reading.
Penside,	" Reading.
Priceburg,	" Scranton.
Parsons,	" Wilkes-Barre.
Pen Mar,	" Waynesboro.
Rutherford,	" Harrisburg.
Royersford,	" Phoenixville.
Reading,	Metropolitan Electric Co.
Richlandtown,	See Allentown.
Roseto,	" Easton.
Reedsville,	" Lewistown.
Ridley Park,	" Philadelphia.
Rutledge,	" Philadelphia.
Rockdale,	" Philadelphia.
Rosedale,	" Reading.
Ringling Rocks,	" Reading.
Rouzerville,	" Waynesboro.
Red Lion,	" York.

Steelton,	See Harrisburg.
Sunbury,	Northumberland Co. G. & E. Co.
Selinsgrove,	See Sunbury.
Schwenksville,	" Norristown.
Spring City,	" Phoenixville.
Shamokin,	Penna. Ltg. Co.
Shenandoah,	See Mahanoy City.
Scranton,	Scranton Electric Co.
Slatington,	See Allentown.
Stroudsburg,	" Easton.
E. Stroudsburg,	" Easton.
Schickshinny,	" Kingston.
Sugar Notch,	" Kingston.
Swoyersville,	" Kingston.
Strong,	" Mt. Carmel.
Swarthmore,	" Philadelphia.
Sharon Hill,	" Philadelphia.
Shillington,	" Reading.
Smithfield,	" Scranton.
Shady Grove,	" Waynesboro.
Stony Brook,	" York.
Trappe,	" Norristown.
Trumbauersville,	" Allentown.
Tamaqua,	" Pottsville.
Temple,	" Reading.
Throop,	" Scranton.
Taylor,	" Scranton.
Trevorton,	" Shamokin.
Upland,	" Chester.
Vandling,	" Scranton.
Vallmont,	" Williamsport.
West Chester,	Phila. Suburban G. & E. Co.
Wilkes-Barre,	The Wilkes-Barre Company
Williamsport,	Citizens Electric Company.
Williamsport,	Lycoming-Edison Company.
Walnutport,	See Allentown.
Wind Gap,	" Easton.
Warriors Run,	" Kingston.
Wyoming,	" Kingston.
W. Wyoming,	" Kingston.
Woodlyn,	" Philadelphia.
Wyomissing,	" Reading.
Waynesboro,	Waynesboro El., Ht. & P. Co.
Wayne Heights,	See Waynesboro.
Windsorville,	" York.
Yeagerstown,	" Lewistown.
Yeadon,	" Philadelphia.
York,	Edison Lt. & Power Co.
York,	Merchants E. L. H. & P. Co.
Yoe,	See York.
Zollinger,	" Waynesboro.

ATTITUDE OF UTILITIES.

Almost without exception the attitude of the officials met in this work was one of helpful co-operation. All the information asked for was freely and fully given, and in many cases a great deal more. The manner of going about the work of regulation as instanced by the public hearings held before the adoption of the Rules and later by the sending of agents to the utilities to confer with them concerning their individual problems, was the subject of many favorable remarks, and justified the judgment of the Commission in this course. Expressions of confidence in the Pennsylvania Commission and favorable to Commission regulation were common.

One manager refused to let his superintendent take refuge behind any acts or rulings of the Commission, preferring to take the brunt of the consumer's ire himself, lest a wrong and unfavorable impression get abroad among private consumers.

Criticisms were freely offered by some, but always in a constructive sense. Common among this class of comments was the expression that there appeared to be a lack of co-operation among the different departments of the State, or among the different bureaus within a department, as evidenced by requests for information and data already furnished, and requiring a duplication of bother and expense on their part. Another, which was more often a fear, rather than a complaint, concerning the delays oftentimes experienced by utilities, incident to the approval of contracts, and still a third pertained to collection by the Commission of quantities of useless information.

REMARKS ON GENERAL CONDITIONS.

Partly due to the fact that the survey here reported covered the larger and better organized companies, the conditions which were found to exist were quite generally in line with the requirements of the Commission. No attempts were made by the utilities to justify such practices as were objectionable under the Rules, and it appears that the Commission will have only to point the way to secure prompt response.

METER TESTING.

The method of testing consumers' meters by rotating standards is universally employed by the companies inspected. In all but a few of the smaller companies, periodic tests have been made previous to 1914, and in these few plans are under way for inaugurating periodic tests. The rotating standards used are generally sent to the manufacturer for calibration at intervals of from one to two years. A suitable check meter has been recommended where none was provided.

Test benches and appliances suitable to the needs of the utility are quite generally found, but are often used for repair work and as catch-alls for store rooms and meter shops. This practice should be discontinued.

METER RECORDS.

There is a wide difference in the method of keeping records and of keeping track of meters. Except in the case of utilities which have recently revised their practice in this regard, it is rarely ever found that all of the information

desired, is kept, though in a large majority of cases, the most essential information is kept on file. In absence of any standards of forms in which these records are to be kept, the inspector has thus far taken the position that if the required information was available in reasonable convenient forms, nothing further could be required at this time.

STATION VOLTAGE RECORDS.

Graphic recording voltmeters are quite generally provided in the generating stations. The purpose of Rule III, Circular 10-A, was partly to indicate the quality of the voltage regulation of the station, and partly to furnish a record of continuity of station operation. The question as to whether or not a graphic wattmeter would serve the purpose, has been raised. While it would serve the latter purpose, it could not serve the former, so it does not seem advisable to allow the substitution.

COMPLAINT RECORDS.

All companies keep, or would keep, if any were received, written complaints. Probably ninety-nine out of every hundred communications from consumers regarding service are given over the phone. Many companies keep a memoranda of all such communications and the action taken in regard to them, while others make no pretense of keeping any memoranda whatever after the complaint has been satisfied.

VOLTAGE SURVEYS.

The practice of making voltage surveys is not as common as it should be. In only a few of the utilities investigated is there any systematic effort made to determine just what the regulation is at the consumer's premises. The common practice is to investigate on complaint using indicating instruments. This feature of operation has an important bearing on the quality of service rendered and should be strengthened by using graphic meters, according to some fairly definite schedule.

INSPECTIONS.

Only a very few of the utilities visited make what might be called "periodic inspections". One company makes such an inspection annually in the nature of an inventory and appraisal for the purpose of charging off depreciation. Two companies make an annual inspection in the early spring for the purpose of planning their repair and renewal work for the summer. Several companies depend upon an annual inspection of the Borough or city inspectors for which they pay a pole tax to the municipality. The large majority of companies depend for their knowledge of the condition of the plant upon the more or less constant inspection which is carried on by the lineman, meter readers, arc lamp trimmers, and other employes who go over the system. It is urged that some fairly definite plan involving a statement of the physical condition of the property and needed repairs, replacements, etc. be adopted. This might take the form of a report from the superintendent to the manager, or from the manager or other executive to the directors. This inspection should preferably be made by an outside man not an employe, who is uninfluenced by knowledge of local conditions and can, therefore, give an unbiased statement of the actual conditions. Constant asso-

ciation with a given plant or property does not seem conducive to a critical report.

To proceed intelligently toward the completion of the work certain information should be compiled. That which commends itself as likely to be most useful is

1st. A complete file of all cities, towns and villages in the State, alphabetically arranged, showing

- (a) Name.
- (b) Location (County and on what R. R.).
- (c) Mail address.
- (d) Population.
- (e) By what company or companies served.

2nd. A complete file of all electric light and power companies in the State arranged alphabetically, showing:

- (a) Name. (b) P. O. Address.
- (c) Whether operating or inactive.
- (d) Whether merged into another company or not and if so, the name of the succeeding company and date of merger.
- (e) Whether or not is it a merger and if so the names of the constituents companies and dates of merger.
- (f) Whether or not it is itself owned or controlled by another company or management corporation and if so, the name.
- (g) The cities, towns and villages served by it.

3rd. A complete file of all holding companies, management corporations, foreign and domestic—doing business in the State, showing:

- (a) Name. (b) Corporate address.
- (c) List of all companies owned or operated by it in the State of Pennsylvania.

To conclude the work begun, and give each utility something definite to work on in making the desired changes, it seems necessary to write each utility visited a letter calling attention to Circular 10-A, and particularly the deficiencies noted in the recommendations.

Note:—Three companies which it was planned to visit were omitted at the end for lack of time. These are:

West Penn Electric Company, Pittsburgh.
Penn Central Electric Company, Altoona.
Citizens Light, Heat and Power Company, Johnstown.

Less than a week's work in addition to that already done, would affect a large additional portion of the meters in service—and of the population. Definite recommendations on many of the utilities have not been made owing to the desirability of determining on some of the details of acceptable practice before asking for changes.

Respectfully submitted,

(Signed) L. H. HARRIS,
Consulting Engineer."

Survey of Gas, Water and Heating Utilities.

"Harrisburg, Pa., September 14, 1914.

Mr. F. Herbert Snow,
 Chief, Bureau of Engineering,
 The Public Service Commission.

Dear Sir:—

I wish to present in the following report a summary of the results of my survey of the conditions existing in the gas, water and heating utilities visited by me during the past summer.

"PURPOSE."

The chief purpose of the work was to examine the standards and testing facilities maintained by the utilities, their use of the same, the nature and adequacy of their records covering the various items specified in the Rules and Regulations of the Commission and to make recommendations concerning any or all of these items. The inspections necessary to obtain the above information afforded opportunities for placing the Commission and the utilities in closer relation with one another clarifying ideas and concepts for both parties, and offering your representative opportunities to be of service to the Utilities.

"SPIRIT OF UTILITIES."

The attitude of the representatives of the various utilities was without exception a helpful one, every possible assistance was rendered and the information desired was given freely and fully. In nearly every case the sentiment was expressed that it was the desire of the utilities to meet the requirements of the Commission to the best of their abilities and to co-operate with the Commission in making a success of its work.

"SCOPE OF SURVEY."

In view of the better gas records available in the Bureau at the time of planning the Survey, it was decided to map out an itinerary covering all gas utilities whose yearly output exceeded 20,000,000 cubic feet and to inspect as many water and steam heating utilities as time and circumstances would permit. The first portion of the summer was devoted to an inspection of the artificial gas companies in the eastern and central portions of the State. The inspection work done during August was chiefly in the natural gas regions, due to time limitations this work was not as comprehensive as the survey of the artificial gas industry. The lists on file in the Bureau show that at least 36 natural gas utilities and 38 artificial gas utilities are yet to be inspected and I feel sure that these lists are not complete. Of the 38 artificial gas companies yet to be inspected, 31 are small companies supplying less than 1000 consumers. In table A, and B of this report are given lists of the artificial and the natural gas utilities inspected to date. Seventeen water utilities and 8 steam heating utilities were inspected and are listed in tables C and D respectively. For the reasons noted above, these surveys are far from being complete.

“RESULTS OF INSPECTIONS.”

The information obtained as a result of the inspections is on file in the Bureau in the shape of: (a) Form notes covering the various items specified in the Rules and Regulations of the Commission. (b) General notes relating to the Utilities. (c) Specific recommendations concerning the testing facilities, records and practices of the utilities. Many of these recommendations are of such a nature that I feel that provision should be made for taking action on the same and forwarding notice of such action to the Utilities concerned.

“PART II.”

“ARTIFICIAL GAS UTILITIES.”

“Meter Testing Facilities.”

The meter testing facilities should consist of a prover or provers, with the necessary accessories, properly located in a room suitable for the purpose. Facilities should be provided for the easy control of the temperature of the water in the prover and for the storage on shelves in the same room as the prover of meters awaiting test. The room should be well lighted and free from draughts, and a prover should not be exposed to direct sunlight or to the radiation from neighboring radiators. In a majority of the cases one or more of the above requirements were not satisfactorily met and suitable recommendations were made. The equipment found in 7 of the utilities was in decidedly bad shape. In the case of 17 of the utilities water for the control of the prover temperature was heated in a bucket at some more or less convenient place. The maintenance of the temperature of the water in the prover at a point differing not more than two degrees from the temperature of the air in the room, is a very important factor in accurate meter testing. Any arrangement which will make easier this control of the temperature will naturally result in better control being maintained. In these cases I have, therefore, recommended that more convenient facilities be installed.

“METER TESTING.”

The character of the testing work being done at the various utilities was determined by direct observation or by an examination of the meter test records and conversation with the man doing the actual testing. In most cases the work is being done very conscientiously, any faults being due chiefly to ignorance. This was particularly so in the case of the control of the temperature of the water in the prover and the prevention of drafts on the prover and on the meter under test.

"REQUEST TESTS."

The utilities generally report a very small number of formal request tests. In the majority of cases the complaint about the accuracy of the meter is received over the telephone or at the office at the time the consumer is paying his bill. In the majority of instances the utilities will test the meter on a reasonable demand without charging therefor. The result of such test is contained in a letter report sent to the consumer, a copy naturally being kept on file. At the Hazleton plant of the Luzerne County Gas and Electric Company the manager raised the question of the right of a utility to test a meter on request without charging therefor. At this utility, as well as at many others, it is considered good business policy to satisfy a consumer by testing his meter if the request is at all reasonable. Strictly speaking, his argument is justified by the wording of Rule 18, and as the determination of the reasonableness of the request rests with the representative of the utility, there is an opportunity for charges of discrimination to arise.

"PERIODIC TESTS."

In the majority of cases the utilities are working on a three year basis, although I understand from some of the representatives of the gas industry that there is a tendency towards lengthening this period. Eight of the utilities visited and inspected do not make periodic tests and several were making such tests in a rather haphazard way; the provisions for insuring a test within a definite period not being as positive as might be desired.

"TESTS PRIOR TO INSTALLATION."

With the exception of the utilities where the meter-testing methods were in decidedly bad shape, it was the general custom to set only such meters as had been tested within 30 days and in smaller companies meters were being tested immediately prior to installation. The record of the inspection of installation was almost universally kept in the shape of work-orders signed by the fitter who had set the meter. In the case of a few of the larger utilities the installation was inspected by a foreman, but no record of such over inspection was being kept.

"ALLOWABLE ERROR."

In the majority of cases the utilities are working on a basis of two per centum fast or slow. One group of utilities adjusts all meters which prove outside of the limit 1.5 per centum fast and two per centum slow; and in one case all meters were adjusted to read two per centum slow.

"METER TESTING RECORDS."

In the majority of cases the meter testing records gave all the information desired except the reasons for test. This, latter item is being added to many of the forms and is considered by the utilities to be a desirable addition. In some cases the temperature of the air and of the water in the prover were not being recorded. These items do not enter into the calculations for the proof of the meter, but they would enable one to judge of the conditions being maintained during test and they also call the attention of the tester to the importance of this feature of the test.

At the office of the Allentown-Bethlehem Gas Company, the chief clerk raised the question of the length of time which meter-testing records must be kept. Where a utility is testing large numbers of meters every day the test-cards soon accumulate in enormous numbers. Where the date and the result of the test are transferred to another record, card or book, it would seem to me that it would suffice to keep only the latest, or possibly the last two test cards.

"METER HISTORY RECORDS."

Two general methods were in use for keeping the history of service meters. One, a large book called the meter-book, in which is kept a complete record of the life of the meter, its various places of installation, its tests, etc.; the other, a card system. The trend seems to be towards the card system method for keeping this information.

The records generally were in excellent shape, although in some instances the dates and results of the tests were not both entered in the history. Five of the utilities visited did not have a meter-history record and several had records which were decidedly incomplete, the information kept being limited to a few items in the meter-reading book.

"CALORIMETER EQUIPMENT."

The facilities for determining the heat value of gas should consist of a calorimeter proper, with all accessories, such as meter, thermometers, water measuring device and water supply tank; properly located in a room suitable for the purpose, and preferably installed in a cabinet. A large number of utilities are just equipping themselves with calorimeter equipment and quite a few should do so. In the majority of cases the instruments are of a satisfactory type and properly set up.

Although a cabinet is not always an absolute necessity, still it is protection for the instrument and it helps to insure proper testing conditions and I have, therefore, recommended in several cases, that the calorimeter equipment be installed in a suitable cabinet. The equipment as a rule is located either in one of the buildings at the plant, or at the district office, the tendency being towards a plant location. In such cases the gas is taken from the city side of the plant governor.

"HEAT VALUE DETERMINATION AND RECORDS."

The number of tests being made vary from three a week to three a day. Because of the infrequency of such tests the character of the work had to be judged entirely from the records, and seemed to be entirely satisfactory in most instances. The test data is usually taken on the form which has been recommended by the Committee on Calorimetry of the American Gas Institute. The results of the tests are usually transferred to the daily works report. In some instances the detailed test data was not being kept in proper shape and suitable recommendations were made.

The average B. T. U. per cubic foot seems to be about 580, with one plant claiming to run as high as 640. This particular plant, The Hyde Park Gas Company of Scranton, maintains a very high candle power, which would account for a high heating value, although I have my doubts as to the correctness of the 640 B. T. U. for a monthly average. My reasons are given in the detailed recommendations concerning this utility.

"PRESSURE SURVEYS."

For the purpose of controlling the pressure throughout the distribution system the utilities maintain a recording gauge at the plant governor and one or more at various points in the distribution system. In the smaller utilities the outside gauge is usually installed in the district office. The charts from these gauges are usually filed in the office of the utility and generally speaking, show very satisfactory conditions. The pressures being maintained on the distribution system range from .25 inches to .40 inches, a rough average being about .30 inches. These figures of course are only very rough approximations.

A regular pressure survey consists of the determination of the pressures existing at a large number of points throughout the system at the same time. Such surveys are usually made once a year at a period of highest demand. The results are then transferred to a blueprint of the distribution system and form a basis for consideration of main extensions. Such surveys are being made by the majority of the utilities under discussion.

"SULPHUR CONTENT."

None of the utilities visited made regular quantitative determinations of the amount of sulphur in their gas. Dependence is placed upon the acetate paper test, made either at the office or at the governor outlet with more or less regularity. A few of the utilities depend entirely upon the test made at the outlet of the purifier boxes. The test papers as a rule are kept only for a short time, although in some instances they are pasted in a book and properly identified.

"COMPLAINT RECORDS."

Although very few of the complaints received by the utilities are written, the majority are keeping a record of all complaints, written or oral, which will give the information called for in the Rules and Regulations of the Commission. These records are usually kept in the shape of work orders, suitably modified to permit of easy analysis. In the case of some of the utilities a separate and distinct list of complaints is being kept in addition to the work-orders.

"SERVICE INTERRUPTIONS."

There seems to be among the utilities some uncertainty as to the exact meaning of this portion of the Regulations, the tendency being to read into the term "service interruptions" a meaning which would make it include trouble encountered by a single individual consumer. My interpretation of the Rule has been that this applies to interruptions of the service being given to a group of consumers. For example, the closing down of the lines supplying a certain street, or a portion of a street, would constitute a service interruption. Almost unanimously the gas companies claim to have no interruptions of this nature. In a broad sense this is practically true, as the gas main are generally tied together by many cross connections and it is possible to tap into a main without shutting off the gas. Some service interruptions are bound to occur, however; and where no separate record of such was provided for, I have made the necessary recommendations. Most of the utilities claim to be able to obtain the required information from their work-order records. While this may

be so, still it is a very indirect method of keeping the required information and I believe a separate record should be kept.

"INSPECTIONS."

The Rules of the Commission require that each utility shall inspect its equipment and facilities and maintain a record of such inspection. The inspections called for in Rule No. 7 may be divided into the every day inspection which insures satisfactory operation, and a periodic over-inspection by either one of the company's engineers or by an outside inspector. The utilities which are controlled by one of the larger holding companies usually maintain such a system of over-inspection in addition to the inspections made by the officials in direct charge of the plant. In the case of utilities which are controlled by the United Gas Improvement Company these inspections are very thorough and a formal report is rendered. In the case of utilities controlled by the American Gas Company the inspections are less formal and the written reports are not rendered to the utilities concerned. The utilities which are controlled by local interests depend upon their superintendent's reports to meet this requirement of the Commission.

"PART III."

"NATURAL GAS UTILITIES."

Due to the wider geographical distribution of consumers the longer transmission lines, the larger volumes to be handled and the larger load variations encountered and other differences in the nature of the service, the natural gas industry has developed methods and solutions differing in many ways from those encountered in the artificial gas industry. Attention will be called chiefly to the items which differ materially from those treated in Part II of this report.

"METER TESTING FACILITIES."

(a) *Positive Meters.*

The requirements for the testing of positive meters have been outlined in Part II of this report and need not be repeated. Generally speaking, the facilities provided for this work were not as acceptable as those encountered in the artificial gas industry and suitable recommendations have been made in the detailed reports.

(b) *Proportional Meters.*

All of the utilities visited have some meters of this type. The larger companies have provided proper testing facilities, the smaller companies and those having only a few proportional meters send them to the manufacturers to be tested and placed in adjustment. The equipment necessary for this work consists of a blower, a flowometer, a barometer, arch gauges and other incidental

apparatus. Where such equipment was installed, it was found to be adequate and in good condition.

As the present Rules of the Commission require that *each* utility shall provide and maintain suitable and adequate facilities for the testing of its gas meters, I would suggest that the Commission adopt suitable regulations providing, in the case of utilities with only a small number of proportional meters, for the testing of such meters by manufacturers or others.

(c) *Orifice Meters.*

Several of the utilities are using meters of the orifice type. Once properly calibrated, the accuracy of such meters is largely dependent upon the accuracy of the recording gauges attached thereto, a feature which simplifies the work of maintaining accurate measurements.

"METER TESTING."

The character of the testing work being done on positive meters left much to be desired, particularly in the items of temperature control, of the condition of the apparatus and of accuracy in the actual testing. The testing of proportional and orifice meters seemed to be done in a careful and accurate manner.

"METER TEST RECORDS."

In the majority of cases the meter test records did not give all the data necessary to check the methods used and the accuracy of the results and did not meet the requirements of Rule XII. In most instances the records were really reports of the results of the tests and not the original test records. It seemed the general custom to jot down the data on scraps of paper and to afterwards transfer the results and some of the data to the record card or book. Such methods encourage the deliberate faking of entries encountered in one of the utilities inspected and in my opinion are absolutely wrong.

"REQUEST TESTS."

Contrary to the general practice in the artificial gas industry, meters tested on request are subject to a charge if found to be correct within the 2% limits. One of the utilities wanted to know the attitude of the Commission concerning a schedule of charges less than the schedule fixed by the Commission and concerning the testing of meters without charge. Similar questions were raised at other places and the point in question merits consideration.

"METER HISTORY RECORDS."

The method developed in the Natural Gas Industry for keeping track of the life history of a meter requires reference to at least three sources of information to determine the items specified in Rule XII. As these items can be determined, I have assumed that such a system meets the requirements of the Commission, even though the information is not massed in one record.

"HEAT VALUE DETERMINATIONS."

The present Rules and Regulations require that each Natural Gas Utility whose yearly output exceeds 20,000,000 cubic feet shall equip itself with a complete calorimeter outfit and shall test its gas at least three times a year.

Of the utilities inspected, two owned calorimeters and only one was making heat value determinations. Several depended upon outside sources for their knowledge of the heating value of their gas. Due to the character of the apparatus, the skill required for its operation and the infrequency of the tests, I would suggest for the consideration of the Commission the advisability of accepting Heat Value Determinations made for the utilities by approved outside sources.

"PRESSURE CONTROL."

In the natural gas industry, due to the long transmission lines and to the wide variations in load, the difficulties of the problem have resulted in the development of very comprehensive systems of pressure control and of line operation. In the individual low pressure distribution districts, dependence is usually placed upon a single recording gauge in the district office. Pressure surveys, in which simultaneous readings are taken at a number of points in a low pressure district, are not made. If trouble is suspected or encountered at any point, the indications of a portable recording or indicating gauge placed at the point in question are depended upon to aid in the solution of the difficulty.

"PART IV."

"WATER UTILITIES."

"GENERAL OBSERVATIONS."

The water utilities, generally speaking, are not as thoroughly organized as are the gas utilities. This statement applies particularly to the records which the utilities are required to keep and to the provisions of the Regulations concerning meter testing and meters. The water utilities are generally controlled by local interests, whereas most of the gas utilities are under the control of one of the larger holding corporations. At several of the plants visited comment was made upon the apparent duplication of inquiries originating in the various Bureaus of the State Government. The general attitude of the utilities seemed to be one of desire to meet the requirements of the Commission fairly and willingly.

Among the utilities visited some were found to be selling water entirely upon a flat rate basis. The majority were selling water upon a flat rate basis to domestic consumers and metering the supply to industrials, hotels, stores, etc., and a few of the utilities were metering all the water which they were selling. In at least one case the utility did not own the meters and the question was raised regarding the responsibility of the utility for the maintenance of the meters and of the records connected with them. Quite a few of the utilities inspected had no meter testing facilities, but all of them appear to have taken up the question of providing the same. Several

of the utilities have facilities adequate for the testing of their smaller meters, but not adequate for the testing of the few larger meters which they almost invariably possess. The sentiment was expressed several times that the Commission should approve certain forms of testing equipment, in order to enable the utilities to purchase such facilities without undue risk.

The records being maintained by the water utilities are decidedly meagre and in very few instances would they meet the requirements of the Commission. The meter records are usually confined to entries in a meter-reading book, giving the size, make, number and present location of the meter. In order to trace out the history of a meter, it would be necessary to go through such a book, page by page. With the exception of five of the utilities a definite complaint record is not being kept. Only one of the utilities visited is keeping service interruption records, which will give the information required by the Rules and Regulations of the Commission. The inspection of the lines and equipment is confined entirely to an operating inspection. In most cases this seems to be very well done.

"METER TESTING FACILITIES."

The Rules and Regulations of the Commission require that each utility shall provide and maintain suitable and adequate facilities for testing its water service meters; and the problem facing each utility is to meet this requirement without undue burden. The problem takes two definite forms: The utility with a large number of meters will have the majority of its meters in the smaller sizes, say 1½ inch and under, with a fair number of the larger size meters running up to six and eight, and even ten inches. Another class of utility, with but few meters and working chiefly on a flat rate basis, will have a smaller proportion of the smaller meters and a larger proportion of the larger meters. The facilities, which are adequate for testing meters under 1½ inch or 2 inch, will seldom be suitable for testing four, six and eight inch meters, because of the difficulty of obtaining the specified test rate of flow and further because the size of the tank will limit the length of run and affect the possible accuracy of the measurements. The facilities which are suitable for measuring a flow of 300 gallons per minute as specified for a six inch meter, if properly used, would do for the testing of the smaller sizes, but would not be well adapted for this work and might easily be used in such a way as to give incorrect results. The removal of the larger size meters for testing is not an easy matter; and, in the case of the smaller utilities with few spare meters, it would be necessary to replace a meter by a section of pipe and adjust the charge for water during the period the meter is out of service and on test.

"TYPES OF TESTING FACILITIES AVAILABLE."

There are various types of testing facilities from which the utilities may select their equipment:

- 1—A metal tank of ample size, mounted on platform scales, with an ample water supply and a method of controlling the rate of flow to correspond with the size of the meter under test, if properly used, would constitute an acceptable meter testing equipment.
- 2—The Mueller and similar testing outfits are practically the same as the above, except that various time-saving features have been incorporated in their construction. For example, facilities for making easier the con-

necting up of the meter, the control of the rate of flow, and the reading of the percentage error directly from the scale-beam. The utility with but few meters to test would hardly be justified in paying the considerably larger price for these time-saving devices. The utility with both large and small meters would probably have to purchase two machines, due to the limitations in the possible rate of flow and in the accuracy of the measurements.

3—The meter testing set placed on the market by the Pittsburgh Meter Company consists of a tank circular cross section, on which is mounted a gauge glass and scale, the latter being graduated in cubic feet and in gallons. The scales on the tanks which I have seen are made of maple, or a similar hard wood, a feature which does not appeal to me. It would seem to me that a scale made of wood is liable to shrinkage and would not possess the permanency which it should have. Before deciding positively against this feature I wish to look into the question at further length. If properly used, such a Volumetric method of calibrating a meter is just as accurate as the weighing method and has the further advantage that the standard is graduated in the same units as the meter, namely, cubic feet or gallons. This type is well adapted for the testing of the smaller meters. For meters above two inches and two and one-half inches the type either becomes unwieldy or else the quantity passing through the meter, and constituting a test run, becomes too small and causes large errors.

4—In the calibration of the larger size meters a modification of type No. 3 may be used, consisting of a cistern which has been calibrated by "weighing in" definite amounts of water and noting the heights. This scheme requires considerable expert handling if it is to give satisfactory results and its possible accuracy is also largely dependent upon the facilities available for determining the height of the water in the cistern and the proportions of the cistern.

5—A fifth method used by some of the utilities in the calibration of the smaller meters consists of the direct comparison of a service meter with a specially constructed test meter. This form is particularly adapted for field work, but if the results of such tests are to be authoritative, the test meter must be checked at frequent intervals. This latter requirement makes it necessary for the utilities to install a tank and scales, or a volumetric standard for this purpose. Having such an equipment, it would usually seem desirable that the service meters should be tested against this primary standard, particularly if the test is a request test.

"APPROVAL OF PROPOSED FACILITIES."

In order to meet questions raised by the utilities, concerning the approval of definite testing machinery, I would suggest that a utility making such inquiry be asked to submit a statement, giving the type and size of the machinery under consideration, the size of the tank, the size of the connections or the available flow, and the sizes of the meters it is proposed to test on this equipment. With such information the Bureau could pass upon the adequacy of the facilities proposed and yet avoid the blanket approval of a given type or make of testing equipment.

“MODIFICATIONS IN THE REQUIREMENTS.”

Some of the questions which the Commission is likely to be called upon to answer are the following: Must a utility provide facilities adequate for the testing of all of its meters, large and small? Must a utility with only a very small number of meters provide its own testing facilities, or would it be allowed to make use of some outside testing facilities? According to the Rules of the Commission they must install such facilities. In the case of utilities with a small number of very large meters, it seems as though such a requirement might with reason be considered burdensome. Several solutions suggest themselves:

A—By special action, the Commission might accept tests made by the meter manufacturers when the latter have the proper facilities, holding however, the utility to a strict compliance with the Rules in so far as the records are concerned.

B—Accepting tests made by some approved laboratory or by some other utility with proper and approved equipment.

C—The Commission might make arrangements for the handling of such tests at the laboratories of the University of Pennsylvania and at the University of Pittsburgh, charging the utility for the work done.

Solutions A and B would answer very satisfactorily for periodic and routine tests. In the case of request tests, at which the consumer cannot always be present, it might be desirable to give him the right of insisting upon Solution C.

“PART V.”

“STEAM HEATING UTILITIES.”

As only eight steam heating utilities were inspected, it is rather difficult to offer any conclusions of value. Four of the utilities are selling on a flat rate basis, the other four fixing their charges on the indications of condensation meters. The meter testing facilities of two of these utilities were acceptable without modification. The most noticeable feature developed by the inspections was the general lack of operating records covering the items specified in the Rules of the Commission. Suitable recommendations were made in each case and are on file with the reports of the inspections.

"PART VI."

TABLE A.—"ARTIFICIAL GAS UTILITIES."

Inspected by H. E. Ehlers.

Name of Utility.	Location.	Number of meters or connections.
Allentown Bethlehem Gas Company,	Allentown,	18,200
Allentown Bethlehem Gas Company,	Bethlehem,	5,000
Altoona Gas Light and Fuel Company,	Altoona,	6,096
Carlisle Gas and Water Company,	Carlisle,	1,300
Chambersburg Gas Company,	Chambersburg,	1,773
Chester County Gas Company,	West Chester,	2,953
Columbia Gas Company,	Columbia,	1,320
Consumers Gas Company,	Reading,	20,000
Counties Gas and Electric Company,	Ardmore,	5,500
Counties Gas and Electric Company,	Conshohocken,	1,776
Counties Gas and Electric Company,	Norristown,	6,200
Eastern Pennsylvania Gas and Electric Company,	Bristol,	1,696
Easton Gas Works,	Easton,	8,622
Gettysburg Gas Company,	Gettysburg,	974
Harrisburg Gas Company,	Harrisburg,	18,500
Hyde Park Gas Company,	Scranton,	23,600
Lancaster Gas Light and Fuel Company,	Lancaster,	9,400
Lebanon Gas and Fuel Company,	Lebanon,	1,469
Luzerne County Gas and Electric Company,	Hazleton,	1,550
Luzerne County Gas and Electric Company,	Kingston and Nanticoke,	4,626
Northern Central Gas Company,	Williamsport,	8,000
Northumberland County Gas and Electric,	Sunbury,	1,750
Philadelphia Suburban Gas and Electric Company,	Chester,	18,765
Philadelphia Suburban Gas and Electric Company,	Coatesville,	1,977
Philadelphia Suburban Gas and Electric Company,	Phoenixville,	2,624
Philadelphia Suburban Gas and Electric Company,	Pottstown,	1,796
The Wilkes-Barre Company,	Wilkes-Barre,	9,467

TABLE B.—"NATURAL GAS UTILITIES."

Inspected by H. E. Ehlers.

Name of Utility.	Location.	Number of meters or connections.
The Citizens Light, Heat & Power Co.,	Johnstown,	8,100
The Manufacturers Light & Heat Co.,	Bellevue,	4,800
The Manufacturers Light & Heat Co.,	Canonsburg,	2,800
The Manufacturers Light & Heat Co.,	Cornopolis,	1,600
The Manufacturers Light & Heat Co.,	McDonald,	2,500
The Manufacturers Light & Heat Co.,	McKees Rocks,	8,200
The Manufacturers Light & Heat Co.,	Pittsburgh,	3,300
The Manufacturers Light & Heat Co.,	Sewickley,	3,300
The Manufacturers Light & Heat Co.,	Washington,	4,570
The Peoples Natural Gas Co.,	Altoona,	55,300
	Pittsburgh,	
	Turtle Creek,	
	Wilksburg,	
The Philadelphia Company:		
Allegheny Heating Company,	Pittsburgh,	95,000
Equitable Gas Company,	Pittsburgh,	95,000
Monongahela Natural Gas Co.,	Pittsburgh,	800
Allegheny Ill. Co. (artificial),	Pittsburgh,	2,400
Consolidated Gas Co. (artificial),	Pittsburgh,	3,700
The T. W. Phillips Gas & Coal Co.,	Butler,	25,200
The United Natural Gas Co.,	Oil City,	16,200

*13,000 total.
†35,500 total.

TABLE C.—“WATER SERVICE UTILITIES.”

Inspected by H. E. Ehlers.

Name of Utility.	Location.	Number of meters or connections.
Angelica Water Co.,	Reading,	250
Bethlehem City Water Co.,	S. Bethlehem,	4,300
Carlisle Gas & Water Co.,	Carlisle,	660
Columbia Water Co.,	Columbia,	2,500
Glenside Water Co.,	Reading,	80
Johnstown Water Co.,	Johnstown,	3,017
Lebanon Valley Cons. Water S. Co.,	Lebanon, .....	.....
Lehigh Water Co. (inc. Easton Water Co.),	Easton,	8,600
Norristown Ins. & Water Co.,	Norristown,	7,000
Pennsylvania Water Co.,	Wilkesburg,	13,774
Pottstown Gas & Water Co. and subsidiaries, ..	Pottstown,	4,500
Scranton Gas & Water Co. and subsidiaries,	Scranton,	20,000
S. Easton Water Co.,	S. Easton,	540
Spring Brook Water Supply Co.,	Wilkes-Barre,	40,000
Sunbury Water Co.,	Sunbury,	2,430
Williamsport Water Co.,	Williamsport,	9,509
Wyoming Valley Water Supply Co.,	Wilkes-Barre,	1,693

TABLE D.—“STEAM HEATING UTILITIES”

Inspected by H. E. Ehlers.

Name of Utility.	Location.	Number of meters or connections.
Allentown Steam Heating & Power Co.,	Allentown,	350
Citizens L. H. & P. Co.,	Johnstown,	340
Hazleton Steam Heating Co.,	Hazleton,	127
Lebanon Steam Co.,	Lebanon,	150
Norristown Steam Heat Co.,	Norristown,	200
Pennsylvania Utilities Co.,	Easton,	217
Reading Steam Heat and Power Co.,	Reading,	300
Wilkes-Barre Co.,	Wilkes-Barre,	437

“PART VII.”

“SUMMARY AND RECOMMENDATIONS.”

The following items are repeated and grouped for your special consideration. In many cases they involve questions of the policy of the Bureau or of the Commission:

- (1) Question of provision for taking action on the detailed recommendations made as a result of the inspections and for notifying the Utilities of such action.

- (2) Question of the right of a Utility to test service meters on request, free of charge, or for a charge less than the charge specified in the Rules of the Commission.
- (3) Question of the acceptance of tests made by manufacturers, or other outside parties on proportional or orifice gas meters in the case of utilities having only a small number of such meters.
- (4) Question of the acceptance of heat value determinations made for natural gas utilities by outside parties.
- (5) Question of the provision and maintenance of testing facilities, or the acceptance of tests made by manufacturers or other outside parties in the case of water utilities with only a few service meters.
- (6) Question of the provision and maintenance of *complete* testing facilities for testing large and small meters or the acceptance of tests made by manufacturers or other outside parties on large meters in the case of water utilities having only a small number of such large meters.
- (7) Question of the approval by the Bureau of testing facilities proposed for installation by the utilities, particularly with reference to water utilities.
- (8) Question of the correctness of my position that meter history records, service interruption records and the other operating records kept by the utilities are satisfactory when the information specified in the Rules and Regulations of the Commission can be obtained with reasonable facility, even though such information is not massed in separate and distinct records.

The summer's work was intended to be a survey of conditions and there was no expectation of covering all the gas, water and heating utilities in the State. The features developed during the progress of the work and covered in this report convince me that it would be of decided advantage to the Commission to continue and complete the survey. To do so within a reasonable time will require practically the entire service of at least one and probably two competent men. I would suggest the following arrangements:

- (A)—1. The appointment of a competent man to devote practically his entire time to a completion of the survey of the gas utilities. Such a man could probably be obtained for a salary of \$2000 to \$2500 per year.
2. The mapping out of an itinerary to cover all the gas companies, large as well as small, using the Bureau lists and Brown's Directory as a basis for this work. I believe the natural gas utilities and the smaller artificial gas utilities offer many opportunities for the Commission to be of service to the community.
- (B)—1. I believe, because of the very large number of water utilities scattered through the State, that the inspection of the water utilities merits the entire attention of an equally competent man for a considerable period of time and judging from my experiences during the past summer much opportunity exists in this field for developing and up-building the service rendered.

2. In case the Commission does not care to go to the expense of surveying the entire field of water utilities at the present time, I would suggest that the man covering gas utilities continue to include in his work the inspection of as many water utilities as time and circumstances will permit.

(C)—The steam heating utilities in the State are relatively few in number and their inspection might easily be included in the duties of one of the men mentioned in (A) or (B).

(D)—The work of the inspector of meter provers should be widened to include a rigorous snap inspection of the positive meter testing work being done at the various utilities visited. Such an inspection should include the testing, under the eyes of the inspector of meter provers, of a number of service meters previously vested by the utility and a comparison of the results of such tests with the results on record. This work should be positive in its nature and should be made the basis of a report to the Chief of the Bureau. I tried this scheme on many of my later inspections and believe that if it is properly carried out it will repay the small amount of extra time required.

Respectfully submitted,

(Signed) H. E. Ehlers,
Consulting Engineer.

TESTING OF GAS METER PROVERS.

General.

Actual field work testing gas meter provers was started at Harrisburg on July 10th, 1914, by Mr. A. C. Gumbert, Inspector of Gas Meter Provers, under the direction of Prof. H. E. Ehlers. Itineraries were planned following the general lines of the survey of gas companies being undertaken by the Bureau at the same time. Work was also started in the Bureau office upon the preparation of complete record of the gas meter proving facilities throughout the State. These records contain the name and location of the utility, the location of the meter shop or district office in which the prover was maintained and used, the make, size and makers number of the prover and a record of all inspections and tests made upon the same.

Forms.

A number of forms were developed for the purpose of facilitating the work and insuring complete and accurate records some of these are presented herewith in the hope that they may be of service to some other Commission contemplating similiar activities.

It soon became evident as the work progressed that much time was being lost due to lack of preparation for test on the part of the utility and to better this condition a form letter was drafted notifying the utilities of the coming of the Meter Prover Inspector. The letter is presented herewith:

"Gentlemen:—

Mr. _____, our Inspector of Meter Provers, will visit your meter shop about _____, for the purpose of testing your gas meter prover. It will be of considerable help to us, and it will also save time for you, if you will have the following items taken care of before the time of our Inspector's visit to your plant:

Item I. Have all rollers removed, cleaned and oiled and make sure that the rollers are put back in their original positions.

Item II. Have the shaft on the large wheel cleaned, smoothed and oiled.

Item III. Have the prover carefully levelled; in many cases it may prove more satisfactory to level the prover by filling the lower tank to its rim rather than to depend upon the indications of a small spirit level.

Item IV. Make provision for a supply of hot and cold water to enable the adjustment of tank temperatures during the test. If there is not the hot and cold water supply in the prover room, please make arrangements for such a supply. Do not arrange to have the water heated in the same room in which the prover is located. A connection such as is used in a bath tub will be found very convenient, as it will make it possible to control the tank temperatures by running hot or cold water into the tanks through a hose, and the hose can be readily removed from the tank as soon as the temperature is adjusted. Such an arrangement is preferable to an arrangement involving the running of separate pipes directly into the tank.

Item V. Have sufficient weights available to place upon the weight chain to balance the prover bell. These weights must clear the prover at all points in their line of travel. If everything is in proper shape, as it must be to make a test, the bell should stay at any point within the limits of its travel without the need of special adjustment.

Very truly yours, Etc."

The meter provers are being standardized with an immersion type cubic foot bottle. The travel of the bell in the region of the scale between the zero mark and the 2 foot mark, between the zero mark and the 4 foot mark, between the zero mark and the 5 foot mark, etc. when 2, 4, and 5 cubic feet of air are introduced into the prover, is compared with the corresponding distances on the scale and the percentage error then determined.

The following form was designed for the purpose of keeping a complete record of all the test data. It is printed upon $8\frac{1}{2}$ x 11 paper punched for I. P. binders. Experience has shown that a handier arrangement for field work would be to arrange the printing across the $8\frac{1}{2}$ inch width of the paper.

The rules and regulations adopted by the Commission require meter provers to be accurate within the half of one percent and the Public Service Company Law requires the Commission to stamp or seal its approval upon all provers meeting the above requirements. This is being done with a wax seal carrying the name of the Commission, the date of the test and the number of the test. Where the prover is of a type that does not permit of the ready use of a wax seal it is supplemented by a lead and wire seal.

As a matter of record, certificates of accuracy or certificates of notification of failure to meet the requirements of the Commission are filled out in triplicate. The original is given to the utility, the second copy is forwarded to the Bureau office and the third copy is kept by the meter prover inspector. The Certificates of accuracy are $5\frac{1}{2} \times 8\frac{1}{2}$, bound in stub book form and arranged in order, white, yellow and green copies. The white sheets and the yellow sheets are perforated for tearing out and the green sheet is not perforated and remains in the stub book and in the possession of the field man. The certificate of failure to meet the requirements of the Commission has been printed upon $8\frac{1}{2} \times 11$ sheets similarly arranged as far as color of paper, stub book arrangement etc. is concerned. The arrangement of the material on these forms is given below.

Form E. B. 12.

THE PUBLIC SERVICE COMMISSION OF THE No.....
COMMONWEALTH OF PENNSYLVANIA.

BUREAU OF ENGINEERING.

CERTIFICATE OF ACCURACY OF METER PROVER.

To the

At.....

....., County, Pa.

This is to certify that the following instrument has been tested and found to be correct within the requirements of the Commission.

Make of Prover....., Maker's No.....

Commission's Identification No.....

Number of Test,.....

Issued....., 19.... Inspector.

No.....

THE PUBLIC SERVICE COMMISSION OF THE
COMMONWEALTH OF PENNSYLVANIA.

BUREAU OF ENGINEERING.
METER PROVER TESTS.

NOTIFICATION OF FAILURE TO MEET THE REQUIREMENTS OF
THE COMMISSION.

To the.....
(Name of Utility).

At.....
(Municipality). (County).

Tests made on.....on the.....prover,
(Date). (Make of Prover).

No....., located at.....show that;
(Maker's No.) (Size). (Street and Number).

The Prover Bell and Scale are in error as follows:

at 2 cubic feet.....%	at 10 cubic feet.....%
at 4 cubic feet.....%	at 12 cubic feet.....%
at 6 cubic feet.....%	

The Commission requires an accuracy of $\frac{1}{2}$ of 1%, and it will therefore be necessary to recalibrate or to replace the above mentioned Prover.

The air and water thermometers.....
.....

Miscellaneous.....
.....

Issued.....
(Date). (Inspector).

The Results of Field Work.

During the year the actual time devoted to the testing of gas meter provers in the field was 45 weeks. In this time the Inspector visited 97 meter shops throughout the State located as set forth in detail

in accompanying table No. 1. This table gives the name of the utility and the location of the meter shop, the total number of provers inspected and detailed data relative to acceptance or rejection.

GAS METER PROVERS TESTED BY BUREAU OF ENGINEERING, PUBLIC SERVICE COMMISSION OF PENNSYLVANIA, JULY 1, 1914 TO JUNE 30, 1915.

Location.	Utility.	Total number of provers.	Certified first test.	Rejected first test.		Certified subsequent test.	Total No. of inspections or tests.
				Poor condition or facilities.	Inaccurate.		
ADAMS COUNTY:							
Gettysburg,	Gettysburg Gas Company,	1	1	.....	.....	.....	1
ALLEGHENY COUNTY:							
Bellevue,	Manufacturers Light & Heat Co.,	1	1	.....	.....	.....	1
Coraopolis,	Manufacturers Light & Heat Co.,	1	.....	.....	1	.....	2
Glenshaw,	Glenshaw Natural Gas Company, ..	1	1	.....	.....	.....	1
McKees Rocks,	Manufacturers Light & Heat Co., ..	1	1	.....	.....	.....	1
Pittsburgh,	Allegheny Heating Company,	1	1	.....	.....	.....	1
	Equitable Gas Company,	5	4	.....	.....	.....	5
	Manufacturers Light & Heat Co., ..	3	.....	1	.....	.....	2
	Monongahela Natural Gas Company, ..	1	1	.....	.....	.....	1
	Philadelphia Company,	1	1	.....	.....	.....	1
	Peoples Natural Gas Company,	3	1	.....	1	.....	2
	Union Gas Company,	1	1	.....	.....	.....	1
Sewickley,	Manufacturers Light & Heat Co., ..	1	1	.....	.....	.....	1
Turtle Creek,	Peoples Natural Gas Company,	1	1	.....	.....	.....	1
West Elizabeth,	Rock Run Fuel Gas Company,	1	1	.....	.....	.....	1
Wilksburg,	Peoples Natural Gas Company, ..	2	.....	1	1	1	3
ARMSTRONG COUNTY:							
Apollo,	American Natural Gas Company, ..	1	1	.....	.....	.....	1
Ford City,	American Natural Gas Company, ..	1	.....	1	.....	.....	2
Kittanning,	American Natural Gas Company, ..	1	.....	.....	1	1	2
Leechburg,	American Natural Gas Company, ..	1	.....	.....	1	1	2
Rural Valley,	American Natural Gas Company, ..	1	1	.....	.....	.....	1
BEAVER COUNTY:							
Ambridge,	Ambridge Gas Company,	1	1	.....	.....	.....	1
Beaver Falls,	Manufacturers Light & Heat Co., ..	1	1	.....	.....	.....	1
Monaca,	Crescent Oil & Gas Company,	1	1	.....	.....	.....	1
New Brighton,	Manufacturers Light & Heat Co., ..	1	1	.....	.....	.....	1
Rochester,	Manufacturers Light & Heat Co., ..	1	.....	1	1	.....	2
Woodlawn,	Peoples Natural Gas Company,	1	.....	.....	1	.....	1
BERKS COUNTY:							
Reading,	Consumers Gas Company,	2	1	.....	1	.....	2
BUCKS COUNTY:							
Bristol,	East Pennsylvania Gas & Electric Company,	1	.....	.....	1	.....	1
BUTLER COUNTY:							
Butler,	Independent Natural Gas Company, ..	1	.....	1	.....	.....	1
	C. W. Phillips Gas & Oil Company, ..	1	1	.....	.....	.....	1
Slippery Rock,	Slippery Rock Light & Heat Co., ..	1	1	.....	.....	.....	1
Zelienople,	American Natural Gas Company, ..	1	.....	1	.....	.....	1
CHESTER COUNTY:							
Coatesville,	Philadelphia Suburban Gas & Electric Company,	1	.....	.....	1	.....	1
Phoenixville,	Philadelphia Suburban Gas & Electric Company,	1	.....	1	.....	1	2
West Chester,	Chester County Gas Company,	1	.....	.....	1	.....	1
CLARION COUNTY:							
East Brady,	East Brady Gas Fuel Company, ..	1	.....	1	.....	1	2
CLEARFIELD COUNTY:							
Clearfield,	Penn Public Service Company,	1	1	.....	.....	.....	1
DuBois,	United Natural Gas Company,	2	2	.....	.....	.....	2
CRAWFORD COUNTY:							
Meadville,	United Natural Gas Company,	1	1	.....	.....	.....	1
Titusville,	United Natural Gas Company,	1	1	.....	.....	.....	1

GAS METER PROVERS TESTED JULY 1, 1914 TO JUNE 30, 1915—Continued.

Location.	Utility.	Total number of provers.	Certified first test.	Rejected first test.		Certified subsequent test.	Total No. of inspections or tests.
				Poor condition or facilities.	Inaccurate.		
CUMBERLAND COUNTY:							
Carlisle,	Carlisle Gas & Water Company, ..	1	....	....	1	....	1
DAUPHIN COUNTY:							
Harrisburg,	Harrisburg Gas Company,	3	2	1	....	....	3
DELAWARE COUNTY:							
Chester,	Philadelphia Suburban Gas & Electric Company,	3	3	....	....	....	3
ELK COUNTY:							
Johnsonburg,	Consumers Gas & Heat Company, ..	1	....	1	....	....	1
Ridgway,	Ridgway Light & Heat Company, ..	1	....	1	....	....	1
St. Marys,	St. Marys Gas Company,	1	....	1	....	....	1
ERIE COUNTY:							
Corry,	Pennsylvania Gas Company,	1	....	1	....	1	2
Erie,	Pennsylvania Gas Company,	3	2	1	....	....	3
FRANKLIN COUNTY:							
Chambersburg,	Chambersburg Gas Company,	1	....	1	....	1	2
Waynesboro,	Waynesboro Gas Company,	1	....	1	....	1	2
GREENE COUNTY:							
Waynesburg,	Waynesburg Home Gas Company, ..	1	1	....	....	....	1
INDIANA COUNTY:							
Blairsville,	Peoples Natural Gas Company,	1	1	....	....	....	1
Indiana,	American Natural Gas Company, ..	1	....	....	1	....	1
LACKAWANNA COUNTY:							
Scranton,	Hyde Park Gas Company,	1	1	....	....	....	1
LANCASTER COUNTY:							
Columbia,	Columbia Gas Company,	1	1	....	....	....	1
Lancaster,	Lancaster Gas Light & Fuel Co., ..	1	....	....	1	....	1
LAWRENCE COUNTY:							
Elwood City,	Manufacturers Light & Heat Co., ..	1	....	....	1	....	1
New Castle,	Manufacturers Light & Heat Co., ..	1	....	....	1	....	1
LEBANON COUNTY:							
Lebanon,	Lebanon Gas & Fuel Company,	1	1	....	....	....	1
LEHIGH COUNTY:							
Allentown,	Allentown-Bethlehem Gas Company, ..	3	2	....	....	....	3
LUZERNE COUNTY:							
Hazleton,	Luzerne County Gas & Electric Co., ..	1	1	....	....	....	1
Kingston,	Luzerne County Gas & Electric Co., ..	1	....	....	1	....	1
Wilkes-Barre,	Wilkes-Barre Company,	2	2	....	....	....	2
LYCOMING COUNTY:							
Williamsport,	Northern Central Gas Company, ..	1	1	....	....	....	1
McKEAN COUNTY:							
Bradford,	Manufacturers Gas Company,	1	1	....	....	....	1
Eldred,	United Natural Gas Company,	1	1	....	....	....	1
Kane,	Eldred Gas Company,	1	....	1	....	....	1
Smethport,	Kane Gas Light & Heat Company, ..	1	....	1	....	....	1
	McDade Gas Company,	1	....	1	1	....	2
	Smethport Gas Company,	1	....	1	....	....	1
MERCER COUNTY:							
Greenville,	Greenville Natural Gas Company, ..	1	....	1	....	1	2
Grove City,	Crawford and Gregory Gas Co.,	1	....	....	1	....	1
Sharon,	United Natural Gas Company,	1	....	....	1	....	1
MONTGOMERY COUNTY:							
Ardmore,	Counties Gas & Electric Company, ..	2	2	....	....	....	2
Conshohocken,	Counties Gas & Electric Company, ..	1	....	....	1	....	1
Norristown,	Counties Gas & Electric Company, ..	1	1	....	....	....	1
Pottstown,	Philadelphia Suburban Gas & Electric Company,	1	....	1	....	1	2

GAS METER PROVERS TESTED JULY 1, 1914 TO JUNE 30, 1915—Continued.

Location.	Utility.	Total number of provers.	Certified first test.	Rejected first test.		Certified subsequent test.	Total No. of inspections or tests.
				Poor condition or facilities.	Inaccurate.		
NORTHAMPTON COUNTY:							
Easton,	Easton Gas Works,	1	1	....	....	....	1
PHILADELPHIA COUNTY:							
Philadelphia,	Northern Liberties Gas Company, ..	2	1	....	1	....	2
VENANGO COUNTY:							
Emlenton,	Pennsylvania Fuel Supply Co.,	1	1	....	....	....	1
Franklin,	United Natural Gas Company,	1	....	1	....	1	2
Oil City,	United Natural Gas Company,	2	1	1	....	1	3
WARREN COUNTY:							
Tidioute,	United Natural Gas Company,	1	....	1	....	....	1
Warren,	Pennsylvania Natural Gas Co.,	1	....	....	1	1	2
	Warren & Chautauqua Gas Co.,	1	1	....	....	....	1
WASHINGTON COUNTY:							
Canonsburg,	Manufacturers Light & Heat Co., ..	1	1	....	....	....	1
McDonald,	Manufacturers Light & Heat Co., ..	1	....	....	1	....	1
Washington,	Manufacturers Light & Heat Co., ..	2	....	....	2	2	4
WESTMORELAND COUNTY:							
Greensburg,	Peoples Natural Gas Company,	1	1	....	....	....	1
Latrobe,	Peoples Natural Gas Company,	1	....	....	1	....	1
New Kensington,	T. W. Phillips Gas & Oil Company, ..	1	....	1	....	1	2
New Kensington,	Peoples Natural Gas Company,	1	....	1	....	1	2
Vandergrift,	American Natural Gas Company, ..	1	....	....	1	....	1
YORK COUNTY:							
Hanover,	Conewago Gas Company,	1	....	1	....	1	2
York,	York Gas Company,	1	1	....	....	....	1
OUTSIDE OF STATE:							
East Liverpool, Ohio,	Ohio Gas Company,	1	1	....	....	....	1
	Grand total,	119	63	28	30	18	141

In many instances it was necessary to reject provers on the ground of the poor condition of the provers themselves or upon the ground of the unsatisfactory surroundings and facilities. The faults of the prover were usually found to be leaky slides, gummed rollers and general conditions preventing the necessary balance to be obtained. The unsatisfactory conditions surrounding the provers were those preventing the control of room and tank temperatures. In a number of instances no facilities were available for heating the room or for heating the water. In some instances the floor of the meter shop was in such condition that it was impossible to maintain the prover in a level position. Very frequently such unsatisfactory conditions made it necessary to arrange for a second trip to the meter shop in question.

The following summary will prove of interest:

Number of Meter Shops visited,	97
Total number of provers bottled,	119
Total number of tests made on 119 provers,	141
Number of provers rejected—poor facilities or poor conditions,	28
Number of provers rejected—first test—inaccuracy,	30
Number of provers accepted—first test,	63
Number of provers accepted—subsequent test,	18
Number of provers with unsatisfactory thermometers,	20

The above tabulation gives in brief form the result of the year's work and it should be noted that only 45 weeks were devoted to this work. The remaining 7 weeks of the year were lost to this work partly by illness of the Inspector and partly by assignment to him temporarily of other duties.

TESTING OF ELECTRICAL STANDARDS.

General.

The testing of the standards used by the electrical utilities for the purpose of testing their service meters is essentially laboratory work. It was begun in November, 1914, upon the appointment of Mr. H. B. Pratt as Electrical Standards Tester and through the courtesy of the University of Pittsburgh was carried on in the Laboratory of that institution, pending the acquirement of facilities by the Commission, until the end of the fiscal year.

Forms.

A number of forms were developed for the purpose of facilitating the work and insuring complete and accurate records. Some of these are presented herewith in the hope that they may be of service to some other Commission contemplating similar activities.

The following form letter was prepared for the purpose of notifying the utilities concerning the date upon which their equipment was to be submitted for test and indicating in a general way the instruments to be submitted.

"Gentlemen:

In order to carry out the provisions of Article II, Section 1, (W), of The Public Service Company Law, there has been established an Electrical Standardizing Laboratory, located for the time being in Pittsburgh, at the University of Pittsburgh for the purpose of making the necessary tests of the standards of the utilities in accordance with the "Rules and Regulations pertaining to Electrical Utilities" as set forth in Circular No. 10-A of the Public Service Commission of the Commonwealth of Pennsylvania.

You are requested to submit your electrical standards to the Laboratory for test and certification as near (date) as possible.

The facilities which must be so tested include:

First, all rotating standards, used in testing consumers meters;
Second, all indicating instruments used in testing consumers meters;

Third, all secondary standards or check meters, whether rotating standards, service type watthour meters, or indicating instruments, which are used to check the accuracy of the rotating standards or indicating instruments included under items 1 or 2 above; and

Fourth, all shunts, multipliers, and current and potential transformers used with any of the above in testing either the consumers meters or the standards of the utilities included under items 1 or 2 above.

Each separate piece should be tagged and should show the name of the utility owning the same, and the purpose for which it is used. If a shunt or multiplier, the tag should show the number of the instrument with which it is to be used.

All shunt leads, testing plugs, or other accessories must be attached to the instruments with which they are used.

All apparatus shipped to the laboratory must be carefully packed in suitable boxes to withstand transportation. Each piece of apparatus should be protected by at least a 4-inch wall of excelsior or other packing material; and, each piece should be wrapped in heavy brown paper before being placed in the packing material.

Each utility must provide a wooden box or boxes to contain the apparatus shipped by it and the top of each box must be secured by screws. The boxes should be constructed of not less than $\frac{1}{2}$ -inch lumber and no one dimension of the box should exceed 4 feet.

Each separate package as prepared for shipment should be plainly marked with the name of the owning utility and sent to the—

“Electrical Standardizing Laboratory,

University of Pittsburgh,

Pittsburgh, Pennsylvania.

By Prepaid Express.

A letter of transmittal, addressed as above should accompany every shipment, which letter should contain a list of all pieces shipped. Receipt of apparatus will be acknowledged in each case.

Return shipment will be made by express, collect.

If desired, the utility may send the meters to the laboratory by messenger who may witness the test. When this is anticipated arrangements should preferably be made before hand to avoid unnecessary delay of the messenger.

Every piece of apparatus submitted, which in the opinion of the inspector, is not suitable for use as a standard, will not be certified as such.

After the certification of testing equipment by the Commission, those

meters or instruments designated as secondary standards or check meters, should not be used for work other than that properly belonging to such standards.

Yours truly, etc."

General information concerning the utilities and the communities served by them, with particular reference to the meter testing facilities is being compiled by the Bureau and recorded on 5 x 8 cards, reproductions of which are given below. The "Utility Card" has been provided for keeping a record of all of the standards of a given utility on one card, together with general information regarding the nature of the service rendered the community and the meter testing methods employed. The "Municipality Card" has been provided for keeping a record of the different utilities giving electric service in any given municipality.

Form EB-2.

UTILITY CARD.

ELECTRICAL.

Company Name.....

Office Address.....City.....County.....

Operate in.....

.....

.....

.....

.....

.....

Furnish

Nature and voltage of lighting circuits.....

Nature and voltage of power circuits.....

Location of meter dept.

Are meters tested periodically?.....Before installation.....

After installation?.....

No. of rotating standards in use.....

Method of testing rotating standards.....

.....

.....

NUMBER OF METERS IN SERVICE.

CLASS.	NUMBER.	SERVICE TEST METHOD.
Direct Current (A) 100 200		
" (B) 100 200		
" (A) 600		
" (B) 600		
Single Phase (C)		
" (D)		
Polyphase (E)		
" (F)		
" (G)		
" (H)		
Excess Indicators		
Demand Indicators		
Total		
REMARKS:		

MUNICIPALITY CARD.

ELECTRICAL.

MUNICIPALITY, COUNTY,

POST OFFICE ADDRESS, POPULATION,

UTILITY.	ADDRESS.	NATURE OF SERVICE.
.....
.....
.....
.....
.....
.....
.....

Remarks:

.....

.....

.....

.....

.....

.....

Upon receipt of apparatus by the laboratory, the box is opened and the condition of each instrument examined and noted upon 5 x 8 cards reproductions of which are given below. The "Standard Meter Card" is designed to contain all general information concerning a given instrument and a history of all tests made upon it by the laboratory. Various columns in the lower part of the form being filled in by dates thus permitting ready reference to detailed information in other laboratory records as hereinafter described. The "Report of Meter Tests" card contains in addition to general information concerning the standard, information relative to a particular test, the reasons for making it, the date of the test, the results obtained, and the action taken, etc.

REPORT OF METER TEST.

ELECTRICAL.

Owned by.....

Location

Description

Make..... Type..... Maker's No..... Phase..... Wire..... Cycles.....

Amperes.....Volts.....C. T. Ratio.....P. T. Ratio

Test made at.....Date of Test.....

Nature of test.....

Standards used.....

.....

.....

.....

Test made by.....

Checked by.....Certificate forwarded.....

Remarks:

.....

.....

.....

.....

.....

ELECTRICAL.

Owned by.....	Location	Description	Type.....	Maker's No.....
Make	Cycle.....	Phase.....
Amperes.....	Volts.....
Location

[illegible]

If the standard submitted meets the requirements of the Commission, a Certificate of Approval is issued and the copy of the same is given herewith. The certificate is in card form 4 x 5½ printed upon heavy paper and upon blue stock in order to give it a distinctive appearance. The card is to be affixed to the instrument or case in such a manner that it can be readily observed.

THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA.
BUREAU OF ENGINEERING.

This is to Certify That ELECTRICAL STANDARD

Maker..... Maker's No.....
Owned by.....
Was Tested the.....Day of.....191.... and
Approved.
.....
Form EB-6. For the Commission.

In addition to issuing a certificate where the results warrant it and also in cases where the instrument does not meet the requirements of the Commission, a "Report of Test" is sent to the utility owning the same, a duplicate of this report being kept on file in the laboratory. A copy of the form used is given below and hardly requires further explanation. The original is printed upon white stock and the copy upon yellow stock, size of form 8½ x 11.

[illegible][illegible]

The results given are correct, with, plus or minus, of one per cent.

Tested by..... Date of test.....

Remarks

Certified correct,

For the Commission.

TABLE NO. II. ELECTRICAL STANDARDS.

Tested by The Bureau Engineering—The Public Service Commission.

July 1, 1914, to June 30, 1915. Started Tests November 1, 1914.

County and City.	Name of Utility.	Classification of Standards and Results of Tests.										Total of standards.
		Tested—No adjustment.			Tested and adjusted.			Unsuitable Type or Poor Condition.				
		Instruments.	Walthour meters.	Transformers.	Instruments.	Walthour meters.	Transformers.	Instruments.	Walthour meters.	Transformers.		
Allegheny County.	Duquesne Light Company, United Electric Company, .....	..... .....	..... .....	..... .....	..... .....	..... .....	..... .....	..... .....	..... .....	..... .....	16 1
Beaver County.	Beaver County Light Company, .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Bedford County.	Bedford Light, Heat and Power Company, .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Blair County.	Penn Central Light & Power Company, Penn Central Light & Power Company, Home Electric Light and Steam Heating Company, .....	..... ..... .....	..... ..... .....	..... ..... .....	..... ..... .....	..... ..... .....	..... ..... .....	..... ..... .....	..... ..... .....	..... ..... .....	2 2 6
Butler County.	Butler County Light Company, .....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Cambria County.	Citizens Light, Heat and Power Company, Citizens Light, Heat and Power Company, Citizens Light, Heat and Power Company, Citizens Light, Heat and Power Company, Barnesboro-Spangler Electric Light Company, Ebensburg Light, Heat and Power Company, Cresson Electric Light Company,	6 3 1 2 1 2 2

TABLE NO. II—Continued.

County and City.	Name of Utility.	Classification of Standards and Results of Tests.										Total of standards.
		Tested—No adjustment.			Tested and adjusted.			Unsuitable Type or Poor Condition.				
		Instruments.	Watthour meters.	Transformers.	Instruments.	Watthour meters.	Transformers.	Instruments.	Watthour meters.	Transformers.		
McKean County.	Kane.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
	Bradford.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
	Sharon.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Mercer County.	Greenville.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
	Greenville.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
	Greenville.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Somerset County.	Stoyestown.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
	Holsopple.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
	Meyersdale.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
	South Fork.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
	Windbet.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Tioga County.	Wellsboro.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
	Wellsboro.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
Venango County.	Oil City.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	4
	Franklin.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1
	Franklin.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Warren County.	Warren.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
	Warren.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2
Westmoreland County.	Vandergrift.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
	Vandergrift.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	3
Total.		25	8	0	12	103	0	8	10	0	.....	167

Total, 167
 Duplications, due to testing same instrument twice, 14
 Grand total, 153

The Results of the Work of Standardization.

Table No. 2 presented herewith gives the name of the utility, its location, the nature of the standards submitted, and the results of the tests made by the laboratory upon these standards. The standards are divided into the three groups "Instruments," "Watthour Meters," and "Transformers." Thirty-four of the standards submitted met the requirements of the Commission without need of adjustment. One hundred and fifteen of the standards submitted for test were accepted following minor adjustments made by the laboratory. Eighteen standards were submitted in a condition too poor or of a type too unsuitable to warrant testing. Fourteen of these were accepted on subsequent test following repairs or adjustments made by their owners. The following tabulation summarizes the above results and will prove of interest:

	Tested, no adjustment.	Tested and adjusted.	Condition too poor to test.	Totals.
Instruments,	26	12	8	46
Watthour Meters,	8	103	10	121
Transformers,	0	0	0	0
Totals,	34	115	18	167
Duplications due to testing same standard twice,				14
Individual standards submitted for test,				153

The response of the utilities to the request that their standards be submitted for test was very hearty and in only a very few instances were objections raised, these being confined chiefly to the need of shipping these standards. In many cases the utilities sent their meter tester to witness the work of standardization and subsequently expressed themselves as being well pleased with the arrangement.

DESIGN OF LABORATORIES AND ORDERING OF EQUIPMENT.

As the work of the year progressed it became evident that the situation demanded centrally located laboratories belonging to the Commission. The question of standardization work and the best manner of handling it had been given much thought and study co-incidental with the consideration given to the service rules subsequently adopted by the Commission. It was the intention originally to handle this work in the laboratories of some of the educational institutions in the State beginning with the Universities of Pittsburgh and Pennsylvania. As before noted work was actually started under this arrangement at the University of Pittsburgh under the direction of

Professor L. H. Harris. The arrangement was very satisfactory but nevertheless unity of action and procedure, the avoidance of duplication of effort and equipment, and the desirable prestige that would accompany such an arrangement, all pointed towards a centrally located laboratory belonging to the Commission and under its direct control, and it was decided to plan for the installation of the necessary facilities in Harrisburg.

Plans and estimates were prepared providing for a gas and water laboratory at 129 N. 4th Street and an Electrical Standardization Laboratory to be located in certain basement rooms in the State Library, these were submitted in the report to the Commission under date of January, 1915. Further studies were made and reports submitted. It developed that the basement room in the Library would not be available and that all of the room at the building at 129 N. 4th Street would be needed for office purposes and accordingly the Department of Public Grounds and Buildings assigned to the Commission for laboratory use certain rooms in the Day School building located at 5th and North Streets in the Capitol Park Extension.

Final plans and estimates were prepared for the installation of electric, gas and hydraulic laboratories in the Day School Building. The laboratories as proposed were designed to give the Commission:

(1) An Electrical Laboratory, second to none designed for the same field work of standardization, with auxiliary equipment for determining the candle power and distribution curves of lamps in the laboratory and in the field.

(2) A Gas Laboratory thoroughly equipped to do high grade work in the standardization of calorimeters, with auxiliary equipment to carry on field investigations of gas service utilities.

(3) A Hydraulic Laboratory equipment primarily for the accurate standardization in the field of the testing standards used by the water and heating service utilities.

It was estimated that an equipment to meet the above requirements would cost \$10,000, this estimate not including any allowance for improvements needed in the building itself in order to render it useable. Letters requesting bids were issued in April and orders were subsequently placed for the needed apparatus and material and for the work of remodeling the building to suit the needs of the laboratory. A detailed description of the laboratories is reserved for a following report.

Inventory of Equipment.

Co-incident with the ordering of apparatus and equipment arrangements were made for keeping a detailed inventory record of such equipment, and this has been done upon inventory cards 5 x 8 arranged as shown below.

750-6-3 '15.

BUREAU OF ENGINEERING.
THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA.
INVENTORY CARD.

Serial No.....
Maker's No.....

Article	Cost

Maker

Obtained from..... Date.....

Year	1915	1919	1923
	1916	1920	1924
	1917	1921	1925
	1918	1922	1926

PART III.

INVESTIGATION OF FORMAL AND INFORMAL COMPLAINTS.

GENERAL.

Many matters are referred to the Commission by citizens of the Commonwealth in the form of an ordinary letter requesting assistance or advice in matters pertaining to the service or facilities of public utilities. Frequently the writer of such a letter is not in a position to prosecute formal action before the Commission, nevertheless, his troubles appear large to him and warrant attention. It is the practice of the Commission to classify such matters under the heading of "Informal Complaints" and to refer them to the proper Bureau for investigation with the idea that an investigation of the facts and a meeting with the parties interested may result in an adjustment of the differences without the need of a hearing and without the need of formal action on the part of the Commission.

Matters brought before the Commission in the regular manner prescribed by its rules of practice are classed as "Formal Complaints" and are usually referred to the proper Bureau either before or after the hearing as the circumstances warrant.

INFORMAL COMPLAINTS.*

General Procedure.

Informal Complaints referred to the Bureau for investigation are first referred to one of the staff and a decision reached concerning the possibility of satisfying the complaint by correspondence. If this does not seem feasible, arrangements are made for a field investigation and for a meeting with the complainant and with representatives of the utility against which the complaint has been made. In many instances these complaints are largely the result of a misunderstanding and a meeting of the interested parties with the representative of the Commission results in an agreement being reached and the matter brought to a conclusion satisfactory to both parties and to the representative of the Commission. It is the duty of the representative of the Commission to make sure that such adjustments and agreements do not work to the disadvantage of either party or of the general public insofar as it may be interested in the matter.

Some of the matters brought to the attention of the Commission in an informal manner are of such nature that they naturally are amended in such a manner as to become formal complaints. Some of the matters referred to the Bureau for investigation develop in such a way that it is not possible to bring about amicable agreement and these cases are then referred to the Commission for action or for formal hearing as the circumstances seem to warrant.

Informal Complaints Investigated During Fiscal Year.

Thirty-three informal complaints were referred to the Bureau during the fiscal year ending June 30th, 1915, covering questions of service and facilities and questions of rates in water, gas, electric and common carrier utilities. Table No. 3, herewith enumerates these complaints giving the cause of the complaint, the locality, the name of the utility and the disposition of the case by the Bureau. Reference to the table shows that of the 33 complaints investigated, 22 were adjusted without the need of hearing or of formal action on the part of the Commission; 10 were referred to the Commission for action or for hearing as the circumstances seem to warrant, and one investigation was still in an unfinished condition at the end of the year.

FORMAL COMPLAINTS.

General Procedure.

The general procedure of the Bureau in connection with formal complaints that appear to warrant such procedure is quite similar to that followed in the case of informal complaints. Many of these matters, however, are of a nature that does not permit of ready adjustment and they have been referred to the Bureau for investigation and report to the Commission, in order that the Commission may have at its disposal a statement of the general situation as it appears to the Engineering Bureau and may also have at its disposal recommendations of the Bureau concerning the general procedure to be followed in considering the matter, testimony to be sought at the hearings and any other relevant information. Some of these cases are referred to the Bureau subsequent to the hearing with directions to prepare a report based upon the testimony taken and the exhibits offered at the hearings, said report to include suitable conclusions and recommendations for the consideration of the Commission.

Formal Complaints Investigated During Fiscal Year.

Twenty-six formal complaints regarding the service or facilities of public utilities were referred to the Bureau for investigation and report during the fiscal year ending June 30th, 1915, and reports were made to the Commission in all of these matters. Table No. 4

presented herewith enumerates these matters giving the name of the complainant, the utility complained against, the location, and the cause of the complaint. The table further classified these matters under the headings—grade crossings over highways, wire crossings, water utilities, railroads and railways, bridges, electric light and power utilities and gas utilities.

It will be noted that these 26 formal complaints were directed as follows:—

- 4 against grade crossings.
- 5 against dangerous wire crossings or crossings not in conformity with General Order No. 11.
- 10 against the rates or the services of water utilities.
- 1 against the services and facilities of railways.
- 3 against the services and facilities of electric light and power companies.
- 2 against the condition of bridges.
- 1 against the service of a gas utility.

TABLE NO. III.

INFORMAL COMPLAINTS RELATING TO SERVICE OR FACILITIES INVESTIGATED BY BUREAU OF ENGINEERING
DURING FISCAL YEAR ENDING JUNE 30, 1915.

No.	Date Received.	Cause of Complaint.	Locality.	Utility.	Disposition. See Note.*
1	1914	Meter registering too fast.	Port Carbon.	Eastern Pennsylvania Light, Heat and Power Company.	A
2	7-1	Defective meter.	Allentown.	Egypt Light, Heat and Power Company.	A
3	7-17	Service facilities.	Easton.	Pennsylvania Utility Company.	A
4	7-30	Unsafe condition of bridge.	Aetna.	Frerough of Aetna.	B
5	7-30	Toilet facilities.	Elwood City.	Pittsburgh, Harmony, Butler and New Castle Railway Company.	B
6	8-4	Excessive rates.	Greensburg.	Westmoreland Water Company.	B
7	8-13	Defective meter.	Port Carbon.	Eastern Pennsylvania Light, Heat and Power Company.	A
8	9-1	Excessive rates and inferior service.	Gettysburg.	Gettysburg Gas Company.	A
9	9-1	Unsatisfactory pressure conditions.	Hawthorne.	Pennsylvania Fuel Supply Company.	A
10	9-1	Excessive charges for current.	Elwyn.	Leligh Valley Light and Power Company.	A
11	9-8	Interruptions to water supply.	Canton.	Citizens Water Company.	B
12	10-20	Refusal to install meter on supply line.	Lelandon.	Labanon Steam Heat Company.	B
13	11-23	Inadequate water supply.	Scottsdale.	Citizens Water Company.	A
14	11-27	Excessive charges.	Greensburg.	Peoples Natural Gas Company.	A
15	12-1	Excessive charges.	Philadelphia.	Philadelphia Electric Company.	A
16	12-16	Excessive charges for gas.	Catasauqua.	Leligh Valley Light and Power Company.	R
17	1915	Purity of water.	Derry.	Derry Water Company.	A
18	1-1	Dangerous wire crossings.	Jenners-town.	Somerset Telephone Company.	A
19	1-6	Excessive charges.	Phindale.	Philadelphia Gas Company.	A
20	1-8	Inadequate facilities.	Halifax.	Halifax Water Company.	R
21	1-30	Station facilities.	Bella Vista.	Northern Central Railway Company.	R
22	1-30	Expense of changing consumer's facilities from d. c. to a. c. current.	Brookville.	Brookville Solar Electric Company.	A
23	2-6	Excessive charges.	Harrisburg.	Harrisburg Gas Company.	A
24	2-11	Refusal to install meter.	Canton.	Citizens Water Company.	A
25	2-11	Inaccurate meter.	New Kensington.	Kensington Water Company.	A
26	2-13	Excessive charges.	Philadelphia.	Philadelphia Electric Company.	A
27	2-13	Inaccurate meter.	Pittsburgh.	Allegheny Heating Company.	A
28	2-13	Grade crossing.	Green Lake, Phila.	Philadelphia and Reading Railway Company.	A
29	2-4	Excessive charges.	Bloomshurg.	Columbia and Montour Electric Company.	R
30	4-27	Water shut off—non-payment of rent.	Canton.	Citizens Water Company.	R
31	5-11	Poor service.	Canton.	Citizens Water Company.	A
32	5-11	Inferior quality of gas.	Brn Mavr.	Canton and Leiby Farmers Telephone Company.	A
33	7-31	Excessive charges.	Catasauqua.	Counties Gas and Electric Company.	A
				Leligh Valley Light and Power Company.	-

*A Adjusted without formal action by the Commission.

*B Referred to Commission for action or formal hearing.

TABLE NO. IV.

FORMAL COMPLAINTS RELATING TO SERVICE OR FACILITIES INVESTIGATED BY THE BUREAU OF ENGINEERING DURING FISCAL YEAR ENDING JUNE 30, 1915.
GRADE CROSSINGS OF HIGHWAYS.

MAIN LINE:	RAILROAD.	LOCATION.	CAUSE OF COMPLAINT.
	Pennsylvania Railroad & Philadelphia & Reading Railway Co.	Lower Alsace, Cumru and Robeson Townships, Berks County.	Dangerous grade crossing.
	Bessner & Lake Erie Railroad Company,	Greenville, Mercer County,	Dangerous grade crossing.
	Delaware, Lackawanna & Western Railroad Co.,	Hanover Street, Plymouth, Luzerne County,	Dangerous grade crossing.
	Philadelphia & Reading Railway Company,	Lenape, Pocopson Township, Chester County,	Dangerous grade crossing.
WIRE CROSSINGS.			
COMPLAINANT.	UTILITY.	LOCATION.	CAUSE OF COMPLAINT.
Andrew Brown,	Penn Central Light & Power Co.,	St. Benedict, Cambria County,	Dangerous wire crossing.
Luzerne Co. Gas & Electric Co.,	Consumers Light Company,	Plymouth, Luzerne County,	Wire crossings not in conformity with General Order No. II.
Wilkes-Barre St. Railway Co., et al., ...	Consumers Electric Company,	Exeter, Luzerne County,	Wire crossings not in conformity with General Order No. II.
Eastern Ctrwford Telephone Co.,	Cussewago Telephone Company,	Bradford, Bradford County,	Wire crossings not in conformity with General Order No. II.
Penn Central Light & Power Co.,	Raystown Water Power Company,	Mt. Union, Huntingdon County,	Dangerous wire crossings.
WATER UTILITIES.			
Solon C. Thayer,	Beaver Valley Water Company,	Beaver Falls, Beaver County,	Excessive rates and inadequate service. Valuation and appraisal made by Engineering Bureau.
Minnequa Furniture Company,	Canton Water Company,	Canton, Bradford County,	Interruptions in service.
Schuylkill Haven Borough,	Schuylkill Haven Gas & Water Co.,	Schuylkill Haven, Schuylkill County,	Inadequate service.
Peter C. Curry,	Emulton Water Company,	Emulton, Venango County,	Service and rates. Valuation made by Engineering Bureau.
J. H. Whitman,	Canton Water Company,	Canton Borough, Bradford County,	Discontinuance of service.
William P. Winter,	State College Water,	State College, Center County,	Inadequacy of supply and pressure.
Residents of Conshohocken Boro., et al.,	Springfield Consolidated Water Company,	Philadelphia,	Excessive rates. Valuation and appraisal made by Bureau of Engineering.
Chester City,	New Chester Water Co.,	Chester, Chester County,	Rates and service, adjusted by Bureau.
Mt. Union Borough,	Mt. Union Water Company,	Mt. Union Huntingdon County,	Inadequate service.
Apollo-Leechburg Boroughs,	Apollo Water Works Company and Leechburg Water Works Company,	Apollo, Armstrong County,	Rates. Valuation made by Engineering Bureau.
RAILROADS AND RAILWAYS			
E. D. Sensenig,	Lancaster and York Furnace St. Ry. Co.,	Lancaster, Lancaster County,	Poor facilities.

BRIDGES.

Public Service Commission,Philadelphia & Reading Railway Co.,Kohnor Bridge, West Mahanoy Twp., Delay in proceeding with the construction of the bridge.
 Public Service Commission,Harrisburg Bridge Company,Walnut St. Bridge, Harrisburg. Dauphin Delay in making the repairs ordered by the Commission.

ELECTRIC LIGHT AND POWER UTILITIES.

Business Men's Assoc. of Bradford,Bradford Electric Light & Power Co., ...Bradford, Bradford County,Poor street lighting facilities.
 M. L. Cooke, ..Philadelphia Electric Company,Philadelphia,Excessive rates.
 John Lauer,Pennsylvania Utilities Company,Easton, Northampton County,Refusal to give service.

GAS UTILITIES.

O. S. G. Way,Penn Service Company,Clearfield, Clearfield County,Inaccurate meter.

PART IV.

INVESTIGATION OF HIGHWAY CROSSING APPLICATIONS.

General Procedure.

The Public Service Company Law requires all matters, pertaining to the improvement, alteration or construction of crossings, at, above, or below the grade of highways by the main lines or by industrial sidings of all railroads and railways, to be referred to the Commission for its consideration and judgment. Upon receipt of such applications it has been the practice of the Commission to refer them to the Engineering Bureau for investigation and report in order that the Commission may have at its disposal, and before the hearing, if possible, a view of the situation as it appears to the Engineering Bureau. Upon reference to the Engineering Bureau arrangements are made for a field investigation in company with representatives of the petitioner, of the community affected and of neighboring property owners, if the circumstances indicated such to be necessary. Following such field investigation a report is made to the Commission describing the situation in detail and discussing the various solutions possible, their advantages and disadvantages, and recommending conditions to be imposed and matters upon which testimony should be sought at the hearings. The large number of such cases referred to the Bureau during the fiscal year indicates in some measure the importance of this work. For purposes of discussion the applications have been classified under the headings—main line crossings, industrial siding crossings, and applications for elimination of existing crossings, and will be presented under these headings.

TABLE No. V.

MAIN LINE CROSSINGS.

APPLICATIONS INVESTIGATED AND REPORTED UPON BY THE BUREAU OF ENGINEERING.

During the Fiscal Year ending June 30, 1915.

File No.	PETITIONER.	RAILROAD INVOLVED.	LOCATION.	County.	Number of Crossings.
MAIN LINE CROSSINGS.					
STREET GRADE.					
A 324-14	Delaware, Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R.	Great Bend Township.	Susquehanna.	1
A 293-14	Borough of Plymouth.	Delaware, Lackawanna & Western R. R.	Plymouth Township.	Luzerne.	1
A 173-14	Easton & Western R. R.	Easton & Western R. R.	Wilson Road, Palmer Township.	Northampton.	1
A 173-14	Easton & Western R. R.	Easton & Western R. R.	Freemansburg Road, Bethlehem Township.	Northampton.	1
A 173-14	Easton & Western R. R.	Easton & Western R. R.	Hope Road, Bethlehem Township.	Northampton.	1
A 169-14	Greenville Borough.	Bessemer & Lake Erie R. R.	College Avenue, Greenville Borough.	Mercer.	1
A 169-14	Hanover and McSherrystown Street Ry. Co.	Company.	Conewago and Apford Townships.	Adams.	1
A 203-14	Lancaster, Petersburg and Manheim R. R. Co.	Hanover & McSherrystown Street Railway Reading & Columbia R. R.	Manheim Borough.	Lancaster.	1
A 152-14	Montour R. R.	Montour R. R.	Robinson Township.	Washington.	1
A 159-14	Montour R. R.	Montour R. R.	Peters Township.	Washington.	1
A 169-14	Montour R. R.	Montour R. R.	Bethel Township.	Allegheny.	1
A 64-14	Cooper Township.	New York Central & Hudson River R. R.	Windburne Village, Cooper Township.	Clearfield.	1
A 95-15	Grove City Borough.	Pittsburgh, Bessemer & Lake Erie R. R.	Mill Street, Grove City.	Mercer.	1
A 106-15	Pennsylvania R. R.	Pennsylvania R. R.	North Street and Cherry Alley, York.	York.	2
A 91-15	Supervisors of Concord Township, Erie County.	Pennsylvania R. R. and Erie R. R.	Lovell Station.	Erie.	1
A 313-14	City of Philadelphia.	Pennsylvania R. R.	25th and Reed Streets, Philadelphia.	Philadelphia.	1
A 1-15	City of Philadelphia.	Pennsylvania R. R.	25th and Moore Streets, Philadelphia.	Philadelphia.	1
A 263-14	Southern Cambria R. R.	Pennsylvania R. R.	Nanty-Glo.	Cambria.	1
A 263-14	Pennsylvania R. R.	Pennsylvania R. R.	Center Township.	Luzerne.	1
A 271-14	City of Philadelphia.	Philadelphia & Reading Railway.	Emerald and Tulip Sts., Philadelphia.	Philadelphia.	1
A 141-14	Philadelphia & Reading Ry.	Philadelphia & Reading Railway.	Nixon Street, Hummelstown.	Philadelphia.	1
A 188-14	Hummelstown Borough.	Philadelphia & Reading Railway.	Water Street, Hummelstown.	Dauphin.	1
A 39-15	South Fork-Portage Ry. Co.	South Fork-Portage Railway Company L. & Wilkes-Barre Connecting Railway, D. R. R.	Summerhill Borough and Croyle Twp.	Cambria.	1
A 94-14	Wilkes-Barre Connecting Ry.	W. R. R. and Wilkes-Barre Eastern R. R.	Plains Township.	Luzerne.	1

A 91-15	Supervisors of Concord Township, Erie County.	Western New York & Pennsylvania R. R. and Pennsylvania R. R.	Waide Farm Road, Concord Township,	Erie,	1
A 91-15	Supervisors of Concord Township, Erie County.	Western New York & Pennsylvania R. R. and Pennsylvania R. R.	County Line Road, Concord Township,	Erie,	1
A 91-15	Supervisors of Concord Township, Erie County.	Western New York & Pennsylvania R. R. and Pennsylvania R. R.	McCrays Road, Concord Township,	Erie,	1
A 95-15	Grove City,	Pittsburgh, Bessemer & Lake Erie R. R., ..	Howard Street, Grove City,	Mercer,	1
A 110-15	Philadelphia, & Reading Ry.,	Philadelphia & Reading Railway,	Kenn Street, Pottstown,	Montgomery, ...	1
A 100-15	City of Philadelphia,	North Pennsylvania R. R.,	Fisher Avenue, Philadelphia, ..	Philadelphia, ..	1
A 100-15	City of Philadelphia,	Philadelphia & Newton Connecting Ry.,	3rd Street, Philadelphia, ..	Philadelphia, ..	1
					12

Main Line Crossings.

Table No. 5 presented herewith enumerates the applications for the construction or creation of main line crossings at grade of the highway, below the grade of the highway and above the grade of the highway that were referred to the Bureau for investigation and report during the fiscal year ending June 30th, 1915. It will be seen that the applications filed covered 77 proposed crossings, of which 61 were at grade, 4 provided for carrying the highway over and above the railroad and 12 provided for carrying the highway underneath the railroad. During the year the Commission acted upon these applications as follows:—

	Total.	Granted.	Denied.	Withdrawn.	Pending.
At grade,	61	39	2	1	19
Highway overhead,	4	3	0	0	1
Highway underneath,	12	6	1	0	5
Totals,	77	48	3	1	25

TABLE NO. VI.
INDUSTRIAL AND SIDING CROSSINGS.
APPLICATIONS INVESTIGATED AND REPORTED UPON BY THE BUREAU OF ENGINEERING.
During the Fiscal Year ending June 30, 1915.

File No.	PETITIONER.	RAILROAD INVOLVED.	INDUSTRY.	LOCATION.	COUNTY.	Number of crossings.
A 135-14	Catasauqua & Fogelsville R. R. Co....	Central R. R. of New Jersey and Catasauqua & Fogelsville R. R.	H. C. Trexler Ice House,	South Whitellall Township, ...	Lehigh,	1
A 367-14	Catasauqua & Fogelsville R. R. Co ...	Catasauqua & Fogelsville R. R.	Penna. Trojan Powder Co., ...	South Whitehall Township, ...	Lehigh,	1
A 102-15	Central R. R. of New Jersey,	Central R. R. of New Jersey, ..	Lehigh & Wilkes-Barre Coal Company.	Wilkes-Barre,	Luzerne,	1
A 172-14	Easton & Western R. R. Co.,	Easton & Western R. R. Co.,	Wm. Wharton Jr. Co.'s Plant, ...	Palmer & Bethlehem Twp., ...	Northampton, ...	1
A 97-15	Howe & Stender,	Erie R. R.,	Howe & Stender's Plant, ...	Ann Street, Scranton,	Lackawanna, ...	1
A 116-15	Lackawanna & Wyoming Valley R. R. Co.	Lackawanna & Wyoming Valley R. R. Co	Penna. Coal Co.,	Dunmore,	Lackawanna, ...	1
CD 455-15	Thomas Colliery Company,	Lehigh Valley R. R.,	Thomas Colliery,	West Mahanoy Township, ...	Schuylkill,	2
A 135-15	Hillside Stone Company,	Pennsylvania R. R.,	Hillside Stone Company,	Derry Township,	Westmoreland, ...	1
A 86-15	Pennsylvania R. R.,	Pennsylvania R. R.,	R. C. Mountzer Plant,	3rd Street, Charleroi, ...	Washington, ...	1
A 125-15	Pennsylvania R. R.,	Pennsylvania R. R.,	Hoffman & Baldwin's Plant, ...	E. Union Street, Chester, ...	Chester,	1
A 55-15	Pennsylvania R. R.,	Pennsylvania R. R.,	Commercial Coal Mining Co., ...	Jackson Township, ...	Cambria,	1
A 330-14	Pennsylvania R. R.,	Pennsylvania R. R.,	Montgomery & Co. Warehouse	9th Street, Harrisburg, ...	Dauphin,	1
A 205-14	Pennsylvania R. R.,	Pennsylvania R. R.,	Headley Good Roads Co., ...	30th Street, Philadelphia, ...	Philadelphia, ...	1
A 165-14	Pennsylvania R. R.,	Pennsylvania R. R.,	Myers & Santman Plant, ...	Mermaid Lane, Springfield Township,	Montgomery, ...	1
A 234-14	Barto Stone & Cement Block Co.,	Philadelphia & Reading Ry., ...	Barto Stone & Cement Block Company.	Barto, Washington Township,	Berks,	1
A 111-15	Philadelphia & Reading Ry.,	Philadelphia & Reading Ry., ...	J. B. Millard Co.,	Jackson Township,	Lebanon,	1
A 93-15	Philadelphia & Reading Ry.,	Philadelphia & Reading Ry., ...	M. C. Creasy Warehouse, ...	Catawissa,	Columbia,	1
A 42-15	Quemahoning Branch R. R. (B. & O.).	Quemahoning Branch R. R., ...	Consolidated Coal Mine, No. 133.	Jenner Townshi.,	Somerset,	1
A 270-14	Voughthorpey-Pittsburgh Coal Co.,	Pennsylvania R. R.,	Youghthorpey-Pittsburgh Coal Co.	Van Vorhis, Fallowfield Twp.	Washington, ...	1
A 264-14	Pennsylvania R. R.,	Pennsylvania R. R.,	Various Collieries,	Gilberton Borough,	Schuylkill,	1

OVERHEAD.

A 312-14	East Bear Ridge Coal Company,	Schuylkill Traction Company, ...	East Bear Ridge Coal Co., ...	Gilberton Borough,	Schuylkill,	1
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UNDERGRADE.

None.

Industrial Siding Crossings.

Table No. 6 presented herewith enumerates all the applications for industrial sidings at, above, or below grade that were referred to the Bureau for investigation during the fiscal year ending June 30th, 1915. It will be noted that the applications listed propose to create 20 siding crossings at grade and 2 siding crossings above the grade of the highway. During the fiscal year the Commission acted upon applications covering 19 of the 22 crossings, denying one proposed crossing at grade. Two applications applying for 3 proposed crossings are still pending.

TABLE NO. VII.
ELIMINATION OF EXISTING GRADE CROSSINGS.
APPLICATIONS INVESTIGATED AND REPORTED UPON BY THE BUREAU OF ENGINEERING.

During the Fiscal Year ending June 30, 1915.

MAIN LINE CROSSINGS ELIMINATED BY STREET OVER.

File No.	PETITIONER.	RAILROAD INVOLVED.	LOCATION.	COUNTY.	Number of crossings.
A 73-15	Delaware, Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R.	Hopbottom Borough,	Susquehanna, ..	1
A 137-15	Delaware, Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R.	Clark's Summit,	Lackawanna, ..	1
A 54-15	Delaware, Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R.	Crissman Road, Benton Township,	Lackawanna, ..	1
A 91-15	Supervisors of Concord Township,	Western New York & Pennsylvania R. R.	Ormsby Road, Concord Township,	Erie, ..	1
A 99-15	City of Philadelphia,	Philadelphia & Baltimore Central R. R.	53th Street, Philadelphia,	Philadelphia, ..	1
A 100-15	City of Philadelphia,	Pennsylvania R. R.,	Diamond Street, Philadelphia,	Philadelphia, ..	1
A 98-15	City of Philadelphia,	Philadelphia & Reading Ry.,	5th Street Philadelphia,	Philadelphia, ..	1
A 104-14	City of Philadelphia,	Philadelphia & Reading Ry.,	Cambria and A Streets, Philadelphia,	Philadelphia, ..	1
A 79-14	Delaware, Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R.	Hopbottom Borough,	Susquehanna, ..	1
A 60-13	Reading Chamber of Commerce and Berks County Farms Bureau.	Philadelphia & Reading Ry.,	Whitehouse Road, Lower Alsace Township,	Berks,	2
A 276-14	Delaware, Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R.	Myrtle Street, Scranton,	Lackawanna, ..	1
A 331-14	Lackawanna R. R., Scranton Rys. Co., Erie R. R., Delaware & Hudson Co., and New York, Ontario & Western R. R.	R. R., Delaware & Hudson Co., and New York, Ontario & Western R. R.	Simpson Road, Fel Township,	Lackawanna, ..	1
MO410-15	City of Philadelphia,	Pennsylvania R. R. and River Front R. R.	Tulip Street, Philadelphia,	Philadelphia, ..	1
			Belgrade Street, Philadelphia,	Philadelphia, ..	1
			Thompson Street, Philadelphia,	Philadelphia, ..	1
					20

TABLE NO. VII—Continued.

MAIN LINE CROSSINGS ELIMINATED BY STREET UNDER.

File No.	PETITIONER.	RAILROAD INVOLVED.	LOCATION.	COUNTY.	Number of crossings.
A 272-14	Delaware Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R. ...	Theodora Street, Scranton,	Lackawanna, ...	1
A 273-14	Delaware, Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R. ...	Court Street, Scranton,	Lackawanna, ...	1
A 274-14	Delaware Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R. ...	Mellale's Court, Scranton,	Lackawanna, ...	1
A 174-14	Easton Transit Company,	Easton Transit Co. and Easton & Northern R. R.	Palmer and Wilson Townships,	Northampton, ..	1
					4

MAIN LINE CROSSINGS ABANDONED.

A 137-15	Delaware, Lackawanna & Western R. R.	Delaware, Lackawanna & Western R. R. ...	Knapp Street, Clarks Summit,	Lackawanna, ...	1
A 91-15	Supervisors of Concord Township,	Pennsylvania R. R. and Erie R. R.,	Rudy's Road, Corry,	Erie,	1
A 91-15	Supervisors of Concord Township,	Pennsylvania R. R. and Erie R. R.,	Higley's Road, Corry,	Erie,	1
					3

Applications for Elimination or Improvement.

Table No 7 presented herewith enumerates the applications filed with the Commission and referred to the Engineering Bureau for investigation and report dealing with the proposed elimination or improvement of existing grade crossings, either by abandonment or by a separation of grades. It will be noted from the table that applications were filed asking the Commission to approve of plans for the elimination or improvement of 27 existing crossings. Two applications involving 3 crossings were not acted upon by the Commission during the fiscal year. Certificates of Public Convenience were issued in all other cases and provided for the elimination of 18 crossings by carrying the highway over the railroad for the elimination of 3 crossings by carrying the highway under the railroad and for the elimination of 3 crossings by abandonment of the highway.

Summary.

The following summary of the crossing applications and complaints investigated and reported upon by the Engineering Bureau during the fiscal year ending June 30th, 1915, will emphasize the magnitude and importance of this work and will also enable a better view to be had of the general grade crossing situation.

	At Grade.	The High- way over.	The High- way under.	Abandoned Crossings.	Total.
Applications:					
Main Line Crossings,	61	4	12	0	77
Industrial Sidings,	20	0	2	0	22
Elimination,	0	20	4	3	27
Complaints:					
Against dangerous cross- ings,	4	0	0	0	4
Totals,	85	24	18	3	130

Div 4



PART V.

SPECIFICATIONS COVERING CONSTRUCTION OF CROSSINGS OF OVERHEAD LINES OF PUBLIC UTILITIES.

Introduction.

The regulation of wire crossings is vested in the Public Service Commission. Much trouble has been encountered in enforcing the provisions of the law and general orders issued by the Commission thereunder, and finally it was determined by the Commission to inquire into the advisability of establishing a general uniform specification for such crossings, and the Chief of the Bureau of Engineering was authorized to investigate and report on the subject. The following pages set forth what has been done.

Relevant Law.

Article II of the Public Service Company Law defines the duties and liabilities of public service companies and Section (t) thereof reads as follows:

"To obey and abide by all lawful orders and regulations of the commission, made under the provisions of this act, regulating the manner in which the tracks or other facilities of any railroad corporation, street railway corporation, or any other public service company, may be constructed across the tracks or other facilities of any other railroad corporation, street railway corporation, or any other public service company, at grade, or above or below grade, or at any prescribed level; or in which the tracks or other facilities of any railroad corporation or street railway corporation may be constructed across any public highway at grade, or above or below grade: or in which any public highway may be constructed across the tracks or other facilities of any railroad corporation or street railway corporation at grade, or above or below grade; or regulating the manner in which such crossings shall be operated, maintained, and protected, including the stationing of watchmen thereat, installation and regulation of lights, blocks, or other system of signalling, safety appliances, devices or such other means or instrumentalities as the commission may prescribe; as well as to obey and abide by all lawful orders and regulations of the commission, made under the provisions of this act, requiring the alteration, relocation, removal, or abolition of any such crossings,—to the end, intent, and purpose that accidents may be prevented; and also to bear and pay the expenses, damages, or compensation incident thereto, either severally or in such proportions as the commission may determine under the provisions of this act."

Article III of the law relates to the creation, powers and limits of powers of public service companies and section 5 thereof reads as follows:

"Under the approval of the commission, evidenced by its Certificate of Public Convenience first had and obtained, and not otherwise, it shall be lawful for any railroad corporation or street railway corporation to construct its tracks or other facilities across the tracks or other facilities of any other railroad corporation or street railway corporation, or across any public highway, at grade, or above or below grade; or for any public highway to be constructed across the tracks or other facilities of any railroad corporation or street railway corporation at grade, or above or below grade; or for any public service company to construct any of its facilities across the facilities of any other public service company at the same or different levels. And it shall be lawful, upon like approval first had and obtained, and not otherwise, for any public service company to alter, relocate, remove or abolish any such crossing: Provided, however, that in all cases in which the tracks or other facilities of a railroad corporation or street railway corporation cross the tracks or other facilities of another railroad corporation or street railway corporation or a public highway at grade, and such crossing is at the time this act becomes effective in process of abolition, under and in accordance with an agreement or contract entered into with any municipality providing for such abolition, it shall be lawful to proceed with the consummation of such abolition as provided in such agreement or contract, without the aforesaid approval of the commission first being obtained."

Article IV defines the powers and duties of the Commission and Section 12 thereof reads as follows:

"Except in cases in which grade crossings are in process of abolition at the time of the passage of this act, under agreement or contract with a municipality, as set forth in the proviso of section five of article three of this act, the commission shall have exclusive power to determine, order and prescribe, in accordance with plans and specifications to be approved by it, the just and reasonable manner, including the particular point of crossing, in which the tracks or other facilities of any public service company may be constructed across the tracks or other facilities of any other public service company at grade, or above or below grade, or at the same or different levels; or in which the tracks or other facilities of any railroad corporation or street railway corporation may be constructed across the tracks or other facilities of any other railroad corporation or street railway corporation, or across any public highway, at grade, or above or below grade; or in which any public highway may be constructed across the tracks of other facilities of any railroad corporation or street railway corporation at grade, or above or below grade; and to determine, order and prescribe the terms and conditions of installation and operation, maintenance and protection, of all such crossings which may now or hereafter be constructed, including the stationing of watchmen thereat, or the installation and regulation of lights, or such other means or instrumentalities as may to the commission appear reasonable and necessary,—to the end, intent, and purpose that accidents may be pre-

vented and the safety of the public promoted. No such crossing shall be constructed without the approval of the commission, evidenced by its 'Certificate of Public Convenience,' as provided in section five of article three of this act; but in no case shall the approval or consent of any court, board, or other commission or officer, or of any municipality be necessary therefor. *It shall be proper, however, for the commission, by general rule or order, whenever the same can be properly regulated by suitable general rule, to prescribe the terms and conditions under which such crossing may be constructed, operated, maintained, or protected, without the particular approval of the commission."*

General Order No. 2.

The Commission undertook to regulate the matter of the crossing of facilities of one public service company by those of another in the form of an order which was issued January 8, 1914, as General Order No. 2. The following is a copy of it. Briefly, General Order No. 2 permits companies to reach an agreement as to how crossings should be made. In case of dispute as to method of construction, the parties would have to come before the Commission.

THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA.

GENERAL ORDER NO. 2.

In the Matter of the Regulations of the Crossing of Facilities of one Public Service Company with those of another Public Service Company.

And now, January 8, 1914, until otherwise hereafter determined and ordered, any public service company, subject to the provisions of The Public Service Company Law, approved July 26, 1913, before constructing any structures or other facilities across the structures or other facilities of any other public service company, whether underground or above ground, or at the same or different levels, in the absence of an agreement between the public service companies affected, shall serve ten days written notice upon the public service company or companies, whose structures it is so desired to cross, which notice shall specify the nature and character of such contemplated crossing and the exact location thereof, and shall file with the Commission a copy of the notice so served with proof of service thereof.

The public service company or companies desiring to construct such crossings may, after the termination of the period of such notice, proceed therewith in accordance with the specifications contained in the notice unless, within ten days after the service thereof, the public service company or companies affected by such crossing shall serve upon the company or companies proposing to make such crossing and file with the Commission a protest against the construction of the same, or unless without such protest the Commission within ten days of the filing of such notice shall, of its own motion, direct that the crossing shall not be proceeded with.

Such protest shall set forth the reasons which, in the judgment of the protestant, show that the Commission should not approve such crossing, and proof of service thereof, as aforesaid, shall be filed with the Commission within three days of the filing of the protest with the Commission.

The Commission, upon consideration of such notice or protest or both, may fix a time and place for hearing after due notice and determine whether or not such crossing shall be approved. This regulation shall apply to all such crossings between the structures or facilities of any public service company, and the structures or facilities of any other public service company, other than crossings between railroads and street railways, and shall be subject to the specific regulations that may hereafter be adopted by the Commission.

By the Commission,

A. B. MILLAR, Secretary.

General Order No. II.

When it was determined that the provisions of General Order No. 2 were not in strict conformity with the law, General Order No. II superseded General No. 2. This was on August 5th, 1914.

General Order No. II prescribes that the public service company before constructed any structure of facility across the structure or facilities of another public service company shall serve a ten days' notice in writing upon the other company or utility whose facilities are to be crossed. That notice shall specify the nature and character and exact locality of the crossing proposed.

There are hundreds of such crossings being made in Pennsylvania every day. A telephone line into a residence may cross a water pipe, gas pipe, steam heat pipe, trolley wire and other wires, each point of crossing of which would be, under General Order No. II, a crossing requiring ten days' notice, etc. At once it becomes apparent that the public would be enormously delayed and useless expense and trouble involved in complying with the provisions of said order. Nevertheless, these provisions are in conformity with the law, so it has been determined. The following is a copy in full of the order:

THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA.

GENERAL ORDER NO. 11.

(Superseding General Order No. 2.)

In the Matter of the Regulation of the Crossing of Facilities of one Public Service Company by those of another Public Service Company.

And now, August 5, 1914, until otherwise hereafter determined and ordered, any public service company, subject to the provisions of The Public Service Company Law, approved July 26th, 1913, before constructing any structures or other facilities across the structures or other facilities of any other public service company, whether under ground, or above ground, or at the same or different levels, shall serve ten days' (or shorter notice, if specially allowed by the Commission, upon sufficient cause being shown). written notice upon the public service company or companies whose structures it is so desired to cross, which notice shall specify the nature and character, way and manner, of such contemplated crossing, and the exact location

thereof, and shall file with the Commission a true copy of the notice so served, with proof of service thereof; Provided, however, that if an agreement which shall specify the nature and character, way and manner, of the construction of the proposed crossing be in force between the public service company proposing to cross and the public service company whose structures or facilities it is proposed to cross, it shall be sufficient if the above notice, served and filed, with proof of such service, with the Commission, as aforesaid, shall state the exact location of such crossing, and that the same will be constructed in accordance with said agreement and specifications referred to therein, a true copy of the said agreement and specifications being also filed with the Commission together with said notice.

The public service company or companies desiring to construct such crossing may, after the termination of the period of said notice, proceed therewith, in accordance with the specifications as stated or referred to in said notice, as above provided, unless, within the period of said notice, served as aforesaid the public service company or companies affected by such crossing shall serve upon the company or companies proposing to make such crossing, and file with the Commission a protest against the construction of the same, or unless, without such protest, the Commission, within the period of said notice, filed with it as aforesaid, shall of its own motion, direct that the crossing shall not be proceeded with.

Such protest shall set forth the reasons which, in the judgment of the protestant, show that the Commission should not approve such crossing, and proof of service thereof, as aforesaid, shall be filed with the Commission within three days of the filing of the protest with the Commission.

The Commission, upon consideration of such notice or protest, or both, may fix a time and place for hearing, after due notice, and determine whether or not such crossing shall be approved. This regulation shall apply to all such crossings between the structures or facilities of any public service company and the structures or facilities of any other public service company, other than crossings between railroads and street railways, and shall be subject to the specific regulations that may hereafter be adopted by the Commission.

This order supersedes General Order No. 2 upon the same subject.

By the Commission,

A. B. MILLAR, Secretary.

THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA.

ADMINISTRATIVE RULING NO. 11.

In the Matter of the Procedure to be Followed Under General Order No. 11.

(In re Regulation of the Crossing of Facilities of one Public Service Company with those of another Public Service Company).

Whereas, some doubt has arisen as to the proper procedure to be followed under General Order No. 11 of this Commission, it is hereby declared and determined:

(1) Where the Public Service Companies have entered into an agreement, providing for and prescribing the particular point or points of crossing and also the way and manner of the construction thereof, no notice is required to be served upon the company whose facilities are crossed, but notice of the proposed crossing must first be given in writing to the Commission, together with a certified copy of the agreement, and immediately after the crossing or crossings have been constructed, a certificate, duly verified, setting forth that the same have been constructed in accordance with the terms of the agreement, shall also be filed with the Commission;

(2) Where the Public Service Companies have executed general agreements, which do not specify the particular point or points of crossing, but provide for the way and manner of the construction of all crossings, notices as required by General Order No. 11 must be served upon the company whose facilities are crossed and copy of said notices, with proof of service thereof, filed with the Commission, together with certified copy of the general agreement, unless same has been heretofore filed;

(3) Where no agreement exists between the Public Service Companies, with respect to crossings, notices must be served and filed as required by General Order No. 11.

Issued by Order of the Commission,

Approved July 8, 1915.

A. B. MILLAR, Secretary.

COMMONWEALTH OF PENNSYLVANIA, ss:

I do hereby Certify that the foregoing is a true and correct copy of the ADMINISTRATIVE RULING of The Public Service Commission of the Commonwealth of Pennsylvania on the above stated subject.

IN TESTIMONY WHEREOF, I have hereunto set my hand and seal of The Public Service Commission of the Commonwealth of Pennsylvania, this 8th day of July, 1915.

(SEAL)

A. B. MILLAR, Secretary.

The Reason for Uniform Crossing Specifications:

General Order No. II provides that there must be a copy of the ten days' notice and description of the crossing filed with the Public Service Commission, and that if an agreement as to the way and manner of the crossing be agreed to by the parties interested, it shall be sufficient if the notice *served and filed* shall state the exact location of the crossing and that the crossing will be constructed according to the agreement and the specifications; but a true copy of this agreement and specification must be filed with the Public Service Commission, together with said notice.

After ten days the public service company may proceed to construct, if there is no objection. If any objection is interposed, then there must be further delay, including hearings, etc.

The gist of it is that the law and the general order under the law are absolutely unworkable and nobody is paying much attention

to them except in contested cases. Crossings are being put in substantially as they were put in under the old Order No. 2.

As further elucidating the situation, I call your attention to the case of approval of contract between the Eastern Penna. Light, Heat and Power Company and certain other companies for the joint use of one pole. Under the rules of the Commission the cost of a hearing and advertising was represented by the petitioner to be about \$25, while the rents received were to be only twenty cents per year and the right to use the pole subject to termination on thirty days' notice. Hence the attorney for the petitioner stated, "You can readily understand, therefore, that from a business standpoint it will not pay to enter into business contracts of this nature even though it be beneficial to the public. I can find nothing in the Act of Assembly which requires the advertising of hearings in matters of this kind, and it seems to me unnecessary, as all parties to the contract were entirely in accord."

The practicability under the law of establishing a standard specification or general rule prescribing the terms and conditions under which crossings may be constructed, operated maintained and protected without the particular approval of the Commission, was thought to be sufficient warrant for a study of the subject. Consequently, the Commission authorized and directed me to proceed with such study, with the understanding that I should call into co-operation the various interests in Pennsylvania.

Appointment of Standing Committees by State Associations:

Standing committees of the following State associations and corporations were appointed to confer with the engineer of the Commission. The list was as follows:

THE PENNSYLVANIA ELECTRIC ASSOCIATION:

George E. Wendle,	Lycoming-Edison Co., ..	Williamsport.
Chairman,		
George Ross Green,	Phila. Elec. Co.,	Philadelphia.
Henry N. Muller,	Duquesne Light Co., ...	Pittsburgh.
H. M. Blake,	American Gas Co.,	Philadelphia.
John S. Wise,	Harwood Elec. Co.,	Hazleton.
A. H. Manswaring,	Phila. Elec. Co.,	Philadelphia.
Charles Day,	Penn Cen. L. & P. Co.,	Philadelphia.
Paul Spencer,	U. G. I. Co.,	Philadelphia.
C. C. Long,	Metropolitan Elec. Co.,...	Reading.
Thomas Sproule,	Phila. Elec. Co.,	Philadelphia.
Walter E. Long,	Phila. Elec. Co.,	Philadelphia.

THE PENNSYLVANIA STREET RAILWAY ASSOCIATION:

Walter E. Long, Phila. Elec. Co., Philadelphia.

THE PENNSYLVANIA STREET RAILWAY ASSOCIATION:

R. P. Stevens, Chairman, Mahoning & Shenango New Castle and Youngs-
Ry. & Light Company, town, Ohio.
Gordon Campbell, York Railways Co., York.
L. C. Mayer, York Railways Co., York.
C. L. Bailey, Jr., Harrisburg Rys. Co., ... Harrisburg.
Frank B. Musser, Harrisburg Rys. Co., ... Harrisburg.
R. B. Hull, Conestoga Traction Co., Lancaster.
John S. Wise, Jr., Lehigh Navigation E. Co. Hazleton.
L. L. Williams, York Rys. Co., York.
C. M. Cole, York Rys. Co., York.
C. C. Long, Reading Traction & Lt., Reading.
E. H. Davis, Williamsport Rys. Co., . Williamsport.
C. B. Fairchilds, Rapid Transit Co., Philadelphia.
C. S. Tingley, Rapid Transit Co., Philadelphia.
W. B. Rigley, Rapid Transit Co., Philadelphia.

REPRESENTING THE TELEGRAPH AND TELEPHONE INTERESTS:

J. B. Klumpp, Chair-
man, Bell Telephone Co. of Pa.
H. S. Warren, American Telephone and Telegraph Co.
R. E. Chetwood, Western Union Telegraph Co.
J. F. Stockwell, Keystone Telephone Company.
J. F. Skirrow, Postal Telegraph—Cable Co.

REPRESENTING THE PENNSYLVANIA GAS ASSOCIATION:

Nathan Hayward, Chair-
man, United Gas Association or Improvement Co., Phila.
W. R. Rhoades, Northern Central Gas Co., Williamsport.
J. D. Shattuck, American Gas Co., Chester.
L. D. Dutton, Wyncote, Pa.

REPRESENTING THE PENNSYLVANIA WATER WORKS ASSOCIATION.

J. W. Ledoux, American Pipe & Construction Co., Phila.
Morris Knowles, Consulting Engineer, Pittsburgh.
W. C. Hawley, Pennsylvania Water Co., Wilkinsburg.

Conference of November 16, 1914.

With the knowledge and approval of the Commission, I sent out a call for a conference of the members of the standing committees and others interested, to be held in the Senate Caucus Room, Monday, November 16, 1914. Mr. Paul Spencer was elected Chairman, and Henry M. Stine of Harrisburg was elected Secretary.

Counsel Trinkle, Commissioner Tone, and the writer, represented the Commission. Representatives of the Penna. Electric Association, the Penna. Street Railway Association, the Telegraph and Telephone interests, and other interested engineers were present and took part in the discussion. A full and complete report of the proceedings are on file in the Engineering Bureau. The meeting closed following the adoption of a motion to appoint a sub-committee, containing representatives of the electric light and power interests, the telephone and telegraph interests, the street railway interests and the railroads, said sub-committee to prepare specifications covering the construction at crossings of overhead lines of Public Utilities and to submit them to the general committee for its consideration, the general committee then to submit the specifications together with its recommendations in the matter to the Public Service Commission.

The following sub-committee was appointed by Mr. Paul Spencer, Chairman, in conformity with the above motion.

S. M. Viele,Penna. Railroad Company, Altoona.
 D. B. Heilman,Phila. & Reading Railway Co., Reading.
 J. S. Jenks,West Penn Traction Co., Pittsburgh.
 R. P. Stevens,Mahoning & Shenango Ry. & Lt. Co., New Castle.
 R. E. Chetwood,Western Union Telegraph Co., New York City.
 J. F. Skirrow,Postal Telegraph-Cable, New York City.
 Nathan Hayward,Bell Telephone Co. of Penna., Phila.
 Jos. F. Stockwell,Keystone Telephone Company of Phila.
 Thomas Sproule,Phila. Electric Co., Phila.
 G. E. Wendle,Lycoming Edison Company, Williamsport.
 Paul Spencer, Chairman, U. G. I. Company, Philadelphia.

Report of Sub-Committee.

Under date of May 18, 1915, the Sub-Committee addressed a letter of transmittal to the Chief of the Bureau of Engineering, advising him of the completion of the specifications, outlining the procedure followed by the Committee and making definite recommendations concerning the use of such specifications. The letter follows:

"Philadelphia, Pa.,

May 18, 1915.

"Mr. F. Herbert Snow, Chief of Bureau of Engineering,
 Public Service Commission,
 Commonwealth of Pennsylvania,
 Harrisburg, Pa."

Dear Sir:—

"On November 16, 1914, there was held in Harrisburg a meeting of representatives of the various public service utilities of the Commonwealth of Pennsylvania, which was called at your request for the purpose of discussing the requirements of the Public Service Law in reference to the crossing of overhead

conductors of a public service utility and the facilities of any other public service utility.

As the result of the discussion at this meeting, and in accordance with your suggestion, a motion was passed to the effect that a committee should be appointed consisting of representatives of the Steam Railroads, Street Railways, Telegraph Companies, Telephone Companies and the Electric Light and Power Companies operating in the Commonwealth of Pennsylvania; this committee to consider the matter of overhead line crossings; and to prepare for the consideration of the Public Service Commission a set of specifications covering the construction at such crossings.

In accordance with this resolution, the following Committee was appointed:

S. M. Viele,
Pennsylvania Railroad Company.
D. B. Hellman,
Philadelphia & Reading Railway Company.
J. S. Jenks,
West Penn Traction Company (Pittsburgh.)
R. P. Stevens,
Mahoning & Shenango Ry. & Lt. Co. (New Castle.)
R. E. Chetwood,
Western Union Telegraph Company.
J. F. Skirrow,
Postal Telegraph-Cable Company.
Nathan Hayward,
The Bell Telephone Company of Pennsylvania.
Jos. F. Stockwell,
The Keystone Telephone Company of Philadelphia.
Thomas Sproule,
Philadelphia Electric Company.
G. E. Wendle,
Lycoming Edison Company (Williamsport.)
Paul Spencer,
The United Gas Improvement Company (Philadelphia.)

At its first meeting, held in Philadelphia on December 1, 1914, the Committee organized and adopted its rules of procedure, among these rules being the following:

1. That Meetings of the Committee or its Sub-Committee would be held in Philadelphia every Tuesday.
2. That the Committee should prepare engineering specifications for all types of overhead line crossings.
3. That any member should have the privilege of bringing with him to the Committee Meetings non-members, to act as conferees, whenever their presence would be of assistance to the Committee.
4. That the Committee would endeavor to arrive at the adoption of the various clauses of the proposed Specifications by unanimous consent.
5. That in the absence of unanimous consent, any clause under consideration could only be adopted by the favorable vote of four (4) of the five (5) public utility interests composing the Committee.

As provided for above, the Committee was assisted in its work by the fol-

lowing non-members, who attended its Meetings from time to time and advised in the preparation of certain of the paragraphs:

Mr. J. H. M. Andrews, Philadelphia Rapid Transit Company, Mr. J. S. Francis, The Bell Telephone Company of Pennsylvania, Mr. R. J. McClelland, Electric Bond & Share Company (New York), Mr. J. H. McDonald, Pennsylvania Railroad Company, Mr. H. N. Muller, Duquesne Light Company, (Pittsburgh), Mr. A. E. Silver, Electric Bond & Share Company, and Mr. H. S. Warren, American Telephone and Telegraph Company. Mr. Francis acted as secretary for the committee, edited the various sections and prepared the copy for the press. The work of the Committee was divided among various Sub Committees, their work being approved and unified by the Committee of the whole as the work progressed.

In their final shape the Specifications have been approved by each Member of the Committee, and are herewith submitted to you for your consideration and that of the Public Service Commission, with the recommendations that they be adopted by the Commission as covering standards for crossings hereafter constructed and used in connection with any General Rule or Order which the Public Service Commission may issue in accordance with Article V, Section 12, of the Public Service Law."

"In explanation of the Specifications, and of the attitude of the Committee in their preparation, it should be stated that they are intended to cover the crossings of overhead conductors of any utility and the overhead conductors of any other utility, or the tracks and right-of-way of railroads. They are, as far as possible, complete for all types of conductors, and cover definitely the general requirements at the points of crossing, without stating the type of construction in such specific details as to limit it to any particular method.

While the paragraphs are, therefore, necessarily general, and cover conditions and not details of construction, they are believed to be capable of definite interpretations, so as to form the basis of working specifications for the use of the construction men in the field.

The growth of the art of overhead line construction, and the improvements in details, both of methods and materials, are so rapid as to make it unwise, in the opinion of your Committee, to limit the construction to particular types. The very existence in the Public Service Law of the requirements which this Committee is now considering bears witness to the growth in the use of overhead conductors, and to the necessity of regulating their construction. This growth is due to the constantly increasing extension of the communication circuits of the telephone and telegraph companies, and the power circuits of the street railway and light and power companies, and will in the immediate future be augmented by the overhead lines of the railroads for the movement of their trains.

In the face of this rapid growth, it is necessary that any set of mandatory specifications, such as these will be if adopted by the Public Service Commission, should be so drawn as, on the one hand, to protect the interests of the public, and to safeguard the service of each public service utility as against the ignorance or neglect of any other utility, and, on the other hand, so as, subject always to such protection, to permit the freest possible extension of the facilities of all of the utilities as may be necessary to meet the public demands. The Committee had had the above considerations in mind, and believes that the Specifications have been so drawn as to protect the rights of all without placing an unreasonable burden on any utility.

In its work the Committee took under consideration other similar specifications which had previously been prepared, including the Specifications adopted

by the National Electric Light Association in 1911, which Specifications were, with certain revisions, later adopted by the American Electric Railway Association. It also took into consideration the Specifications recently adopted by the Public Service Commission of the State of Idaho, as well as the Specifications which had been adopted by the Public Service Commission of the State of Illinois, the General Regulations Covering Overhead and Underground Construction of Telephone, Telegraph, Signal, Trolley and Power Lines adopted by the Railroad Commission of the State of Oregon, the Act Relating to Electrical Construction of the State of Washington, the Specifications for the Installation and Maintenance of Wire Crossings adopted by the Pennsylvania Railroad Company and the Specifications for Wire Crossings adopted by the Association of Railway Telegraph Superintendents; also the regulations of the Swiss Government in reference to Electrical Installations, and the General Specifications established as standard practice of the Verbandes Deutscher Elektrotechniker.

The above Specifications were, however, used only for reference, and no paragraph of the Specifications as prepared by the Committee was adopted without a careful study of the meaning of the clause and its interpretation as applied to actual construction.

The Specifications are divided into nine (9) Sections, as follows:

Section I is general, covering definitions and setting forth classifications.

Section II covers the construction of Power Lines up to 5,000 volts when crossing Communication Circuits, and Power Lines up to 15,000 volts when crossing other Power Lines. It also covers the crossing of Communication Lines over other Communication Lines. The various paragraphs in this Section require standard construction, with clearances and separations as specified, so as to guard against the possibility of the conductors of any circuit coming in contact with each other, or with the conductors of another line.

Section III covers the construction of Power Lines of over 5,000 volts where crossing over Communication Lines, and of Power Lines of over 15,000 volts where crossing over other Power Lines.

Section IV covers "Collinear Construction." By "Collinear Construction" is meant what is generally known as "overbuilding;" that is, the construction of one line parallel with an existing line, but on separate supports, and so placed in reference to it that one line will be wholly or in part over the other. Such construction is considered to be undesirable, as it is difficult to avoid interference between the two lines. In Section IV it is stated that such construction should so far as practicable, be avoided, but it is recognized that under certain conditions it may be necessary, and the paragraphs of this Section have been included to provide for safe construction when it may be absolutely necessary to build such lines.

Attention is called to the fact that the various paragraphs in Section IV deal only with questions of safety of construction, and that there are other difficulties in connection with Collinear Construction, or with parallel construction between Power Lines and Communication Lines, which have to do with inductive disturbances, which may affect the service of utilities operating Communication Circuits. The paragraphs in Section IV are not intended to include the construction requirements which might be necessary to remove or limit such disturbances. The Committee felt that the question of inductive interference was beyond the scope of its instructions, as inductive effects are not generally

produced by ordinary angle crossings but are due to parallelism. For the protection of the service of the utility owning the Communication Circuits, it may, therefore, in certain cases be necessary for additional methods of construction than those specified to be employed by the utilities operating the Communication Circuits and the Power Circuits.

Section V covers the construction of Communication Lines where crossing over Railroads, and is based upon the Specifications for Wire Crossings adopted by the Association of Railway Telegraph Superintendents.

Section VI covers the construction of Power Lines of all voltages where crossing over Railroads. Sections VI and III are practically identical in their provisions, with the exception of the difference in voltage limitations, and with the exception that in Section VI two (2) paragraphs were added; No. 607, to cover the side clearances from the track rails of the Railroad, and No. 608, to cover the vertical clearances above the tracks of the Railroad. With these two (2) exceptions, the various paragraphs in Section VI are identical with similar paragraphs in Section III. It was deemed wise to repeat these paragraphs in Section VI, so as to make the Section complete by itself as applying to crossings over Railroads.

Section VII covers the construction of Overhead Lines where crossing under Railroad Bridges. Its various paragraphs specify the construction to be used where such lines are attached to the under side of bridges. Special consideration has been given to the necessity of providing ample clearance between conductors of high voltage and any portion of the bridge or its abutments, so that there will be sufficient room for inspecting, painting and maintaining the bridge structure.

Section VIII covers underground construction at points of crossing with Railroads. Under special conditions, due to interfering structures or lines of the Railroad, it might be difficult to construct an overhead crossing in accordance with the requirements of Section VI; in such cases, it may be more economical and for the advantage of all parties in interest, to use underground cable across the Railroad Right-of-Way, connecting this cable at both sides of the right-of-way with the overhead line of which the cable crossing would form a part. Generally a short piece of underground cable, as a section of a line elsewhere built as an open wire overhead line, will increase the chance of interruption to or impairment of the service of the utility owning the line. A section of underground cable in an overhead line is generally a weak point from the standpoint of service. Such construction should, therefore, be avoided, but Section VIII is included in the Specifications to cover such construction where necessary.

The Appendices which are included in Section IX are explanatory of the various paragraphs in the different sections to which they refer. Some of these Appendices include specifications for materials, which are the generally accepted specifications for the material covered. The various tables, such as the tables for sags and for clearances, have been worked out based on the requirements of the paragraphs which cover sags and clearances. They are included for the purpose of reducing the amount of calculations that would be required by any one applying the various paragraphs on the Specifications in construction work. The sketches included in the Appendices are to be considered merely as suggestive, and as illustrating certain methods which can be used to meet the requirements of the various paragraphs to which they refer. They should not be considered as covering the only approved methods of construction to be used in such cases.

In order that these or any similar Specifications can be applied by the various public utilities in such a way as to permit their making necessary extensions to meet the public demands, it seems to the Committee that it will be necessary for the Commission to provide that there shall be between the various utilities who may have occasion to make crossings, a general form of agreement, and that any General Rule or Order which may be issued by the Commission should provide that if such a general agreement between the parties in interest is on file with the Commission, and if the work is to be done in accordance with the requirements of the Specifications as issued by the Public Service Commission, then the necessary work of construction can be done by the utility without the delay incident to making special application, and preparing special plans for each individual case, and applying to the Public Service Commission for a Certificate of Public Convenience.

In conclusion, the Committee wishes to express to you and to the Public Service Commission its appreciation of the opportunity which has been afforded to the various public utilities of the State to assist in the preparation of specifications which affect so materially the interests of all of these utilities."

Respectfully submitted,

PAUL SPENCER,
R. E. CHETWOOD,
NATHAN HAYWARD,
D. B. HEILMAN,
J. S. JENKS,
JOHN F. SKIRROW,
THOMAS SPROULE,
R. P. STEVENS,
JOSEPH L. STOCKWELL,
S. M. VIELE,
G. E. WENDLE.

Proposed Specifications—Overhead Wire Crossings:

The specifications prepared by the Sub-Committee and referred to in the letter just quoted, are as follows:

The Public Service Commission

OF THE

COMMONWEALTH OF PENNSYLVANIA

GENERAL ORDER NO. 13.

In the Matter of the Regulation of the Construction of the Crossing of the Wires of a Public Service Company over or under the Facilities of another Public Service Company.



THE PUBLIC SERVICE COMMISSION OF THE COMMONWEALTH OF PENNSYLVANIA

WM. D. B. AINEY, Chairman,
JOHN S. RILLING,
WILLIAM A. MAGEE,
MILTON J. BRECHT,
JAMES ALCORN,
MICHAEL J. RYAN,

Commissioners.

A. B. MILLAR, Secretary.

F. HERBERT SNOW,
Chief, Bureau of Engineering.

At a meeting of The Public Service Commission of the Commonwealth of Pennsylvania held at its office in the city of Harrisburg, Pennsylvania, on the 27th day of February, 1917.

GENERAL ORDER NO 13

In the Matter of the Regulation of the Construction of the Crossing of the Wires of a Public Service Company over or under the Facilities of another Public Service Company.

WHEREAS, Under the provisions of Article V, Section 12 of the Public Service Company Law, it is provided that no crossing of the wires of a public service company over or under the

(3)

facilities of another public service company shall be constructed without the approval of the Commission and also that it shall be proper for the Commission by general rule or order whenever the same can be properly regulated by suitable general rule to prescribe the terms and conditions under which said crossing may be constructed, operated, maintained or protected without the particular approval of the Commission;

And WHEREAS, The Commission by its General Order No. 11 and its Administrative Ruling No. 8, has heretofore adopted certain rules and regulations governing the procedure to be followed in securing the approval of the Commission to such construction, and whereas, after careful investigation the Commission is convinced that the construction of such crossings of the wires of public service companies over or under the facilities of other public service companies can be regulated by general order without the particular approval of the Commission in such a manner as to provide for a construction which will tend to prevent accidents and promote the safety of the public.

NOW, to wit, February 27, 1917, IT IS ORDERED, That from and after the FIRST day of June, 1917, all crossings of the wires of public service companies over or under the facilities of other public service companies shall be made in accordance with the SPECIFICATIONS COVERING THE CONSTRUCTION AT CROSSINGS OF OVERHEAD LINES OF PUBLIC UTILITIES hereto attached.

AND IT IS FURTHER ORDERED, That from and after said first day of June, 1917, such crossings of wires over or under the facilities of other public service companies may be constructed by the companies lawfully authorized so to do in accordance with said specifications without the particular approval of this Commission on condition that notice of said construction specifying the particular point of crossing shall be given to the public service company whose facilities are to be crossed prior to the beginning of the construction of said crossing.

Protest against the construction of any such crossing may be made to the Commission at any time by filing formal complaint which shall set forth the reasons which, in the judgment of the

protestant, show that the crossing should not be constructed in accordance with the above mentioned specifications, and proof of service thereof upon the company constructing the crossing shall be filed with the Commission within three days of the filing of the protest with the Commission.

This order supersedes General Order No. 11 and Administrative Ruling No. 8 of this Commission upon the same subject only in so far as said General Order and Ruling relate to the construction above ground of crossings of wires over the facilities of public service companies.

By the Commission,

WM. D. B. AINEY, Chairman.

Attest: A. B. MILLAR, Secretary.



SPECIFICATIONS COVERING THE CONSTRUCTION AT CROSSINGS OF OVERHEAD LINES OF PUBLIC UTILITIES

INTRODUCTION.

These specifications were prepared at the request of The Public Service Commission and under the direction of its Chief Engineer, F. Herbert Snow, by a Joint Committee representing the different classes of utilities concerned. Said Joint Committee consisted of Paul Spencer of the United Gas and Improvement Company of Philadelphia (Chairman), R. E. Chetwood of the Western Union Telegraph Company, Nathan Hayward of the Bell Telephone Company of Pennsylvania, D. B. Heilman of the Philadelphia and Reading Railway Company, J. S. Jenks of the West Penn Traction Company of Pittsburgh, J. F. Skirrow of the Postal Telegraph-Cable Company, Thomas Sproule of the Philadelphia Electric Company, R. P. Stevens of the Mahoning and Shenango Railway and Light Company of New Castle, Joseph F. Stockwell of the Keystone Telephone Company of Philadelphia, S. M. Veile of the Pennsylvania Railroad Company, G. E. Wendle of the Lycoming Edison Company of Williamsport and J. S. Francis of the Bell Telephone Company of Pennsylvania (Secretary).

In explanation of the specifications, it should be stated that they are intended to cover the crossings of overhead conductors of any utility and the overhead conductors of any other utility, or the tracks and right-of-way of railroads. They are, as far as possible, complete for all types of conductors, and cover definitely the general requirements at the points of crossing, without stating the type of construction in such specific details as to limit it to any particular method.

While the paragraphs are, therefore, necessarily general, and cover conditions and not details of construction, they are believed to be capable of definite interpretations, so as to form the

basis of working specifications for the use of the construction men in the field.

The Specifications are divided into nine (9) Sections, as follows:

Section I is general, covering definitions and setting forth classifications.

Section II covers the construction of Power Lines up to 5,000 volts when crossing Communication Circuits, and Power Lines up to 7,500 volts when crossing Power Lines of other Utilities. It also covers the crossing of Communication Lines over other Communication Lines. The various paragraphs in this Section require standard construction, with clearances and separations as specified so as to guard against the possibility of the conductors of any circuit coming in contact with each other, or with the conductors of another line.

Section III covers the construction of Power Lines of over 5,000 volts where crossing over Communication Lines, and of Power Lines of over 7,500 volts where crossing over Power Lines of other Utilities.

Section IV covers "Collinear Construction." By "Collinear Construction" is meant what is generally known as "overbuilding"; that is, the construction of one line parallel with an existing line, but on separate supports, and so placed in reference to it that one line will be wholly or in part over the other. Such construction is considered to be undesirable, as it is difficult to avoid interference between the two lines. In Section IV it is stated that such construction should, so far as practicable, be avoided, but it is recognized that under certain conditions it may be necessary, and the paragraphs of this Section have been included to provide for safe construction when it may be absolutely necessary to build such lines.

Attention is called to the fact that the various paragraphs in Section IV deal only with the questions of safety of construction, and that there are other difficulties in connection with Collinear Construction, or with parallel construction between Power Lines and Communication Lines, which have to do with inductive disturbances, which may affect the service of utilities operating Communication Circuits. The paragraphs in Section IV are

not intended to include the construction requirements which might be necessary to remove or limit such disturbances. The Committee felt that the question of inductive interference was beyond the scope of its instructions, as inductive effects are not generally produced by ordinary angle crossings, but are due to parallelism. For the protection of the service of the utility owning the Communication Circuits, it may, therefore, in certain cases be necessary for additional methods of construction than those specified to be employed by the utilities operating the Communication Circuits and the Power Circuits.

Section V covers the construction of Communication Lines where crossing over Railroads, and is based upon the Specifications for Wire Crossings adopted by the Association of Railway Telegraph Superintendents.

Section VI covers the construction of Power Lines of all voltages where crossing over Railroads. Sections VI and III are practically identical in their provisions, with the exception of the difference in voltage limitations, and with the exception that in Section VI two (2) paragraphs were added; No. 607, to cover the side clearances from the track rails of the Railroad, and No. 608, to cover the vertical clearances above the tracks of the Railroad. With these two (2) exceptions, the various paragraphs in Section VI are identical with similar paragraphs in Section III. It was deemed wise to repeat these paragraphs in Section VI, so as to make the Section complete by itself as applying to crossings over Railroads.

Section VII covers the construction of Overhead Lines where crossing under Railroad Bridges. Its various paragraphs specify the construction to be used where such lines are attached to the under side of bridges. Special consideration has been given to the necessity of providing ample clearance between conductors of high voltage and any portion of the bridge or its abutments, so that there will be sufficient room for inspecting, painting and maintaining the bridge structure.

Section VIII covers underground construction at points of crossing with Railroads. Under special conditions, due to interfering structures or lines of the Railroad, it might be difficult to construct an overhead crossing in accordance with the re-

quirements of Section VI ; in such cases, it may be more economical, and for the advantage of all parties in interest, to use underground cable across the Railroad Right-of-Way, connecting this cable at both sides of the right-of-way with the overhead line of which the cable crossing would form a part. Generally, such construction would be undesirable, as the introduction of a short piece of underground cable, as a section of a line elsewhere built as an open wire overhead line, will increase the chance of interruption to, or impairment of, the service of the utility owning the line. A section of underground cable in an overhead line is generally a weak point from the standpoint of service. Such construction should, therefore, be avoided, but Section VIII is included in the Specifications to cover such construction where necessary.

The **Appendices** which are included in **Section IX** are explanatory of the various paragraphs in the different Sections to which they refer. Some of these Appendices include specifications for materials, which are the generally accepted specifications for the material covered. The various tables, such as the tables for sags and for clearances, have been worked out based on the requirements of the paragraphs which cover sags and clearances. They are included for the purpose of reducing the amount of calculation that would be required by any one applying the various paragraphs of the Specifications in construction work. The sketches included in the Appendices are to be considered merely as suggestive, and as illustrating certain methods which can be used to meet the requirements of the various paragraphs to which they refer. They should not be considered as covering the only approved methods of construction to be used in such cases.

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SECTION I.

GENERAL.

SCOPE.

101. Scope. These specifications cover the type of construction to be installed in all cases where the overhead lines of one utility cross over or under the overhead lines of another utility, or over or under the tracks of a railroad.

DEFINITIONS.

102. For the purpose of these specifications certain of the terms used herein are defined as follows:

103. Line. Any aggregation of poles, towers or other supporting structures, together with conductors and other appurtenances carried on such supports.

104. Circuit. Any overhead conductor or combination of conductors which forms a medium or path for the transmission of electrical energy for power or communication purposes.

105. Power Circuit. Any constant potential or constant current circuit used for power, lighting, railway or similar purposes, but not including trolley contact or feeder wires as defined in Paragraphs 111 and 112.

106. Power Line. Any line used mainly for carrying power circuits.

107. Communication Circuit. Any telephone, telegraph or signal circuit not over 750 volts.

108. Communication Line. Any line used mainly for carrying communication circuits.

109. Conductor. Any overhead wire or cable which constitutes part of a power or communication circuit.

110. Attachment. Any crossarm, conductor, guard, wire, guy, cable, apparatus, fixture or other appurtenance, which constitutes a part of a line and is carried by any pole, tower, or other support thereof.

111. Trolley Contact Wire. Any overhead bare conductor from which, by means of an overhead trolley or similar device, electrical energy is transmitted to moving cars or trains.

112. Trolley Feeder. Any conductor used for supplying electrical energy directly to a trolley contact wire at the same voltage.

113. Crossing Span. That portion of the conductors of a line between adjacent line supports, which crosses over the conductors of any other line or lines, or the track or tracks of a railroad.

114. Railroad. Every railroad and railway other than a street railway, by whatsoever power operated, for public use in the conveyance of passengers or property, or both.

115. Street Railway. Every railroad and railway, by whatsoever power operated, for public use in the conveyance of passengers or property, or both, being mainly located upon, over, above, across, through, or along any street, avenue, road, highway, bridge or public place.

116. Normal. The conditions existing at a temperature of sixty (60) degrees Fahrenheit, and with no wind or ice loading.

117. Nominal. Defines the term, dimension, or value (e. g., diameter, operating voltage, etc.) by which a certain size of material, character of circuit, etc., is commonly known in the art, although the actual term, dimension, or value may vary somewhat from the defined condition.

118. Collinear. Defines the condition where one line is built over, under, or along side another line on separate supports (crossings at an angle of fifteen (15) degrees, or over, excepted) so situated that one line is wholly, or partly, over the other line.

119. **Parties in Interest.** A term to be understood as including The Public Service Commission and any other regulating body having jurisdiction and the utilities concerned at the crossing.

CLASSIFICATION.

120. **Classification.** For the purpose of these specifications, circuits or conductors will be designated by class, as follows:

Class	Character and Operating Voltage
A {	A-1 Constant potential, alternating current, not grounded, exceeding 5,000 volts and not exceeding 7,500 volts.
	A-2 Constant potential, one side or neutral grounded, exceeding 2,500 volts alternating current to ground, but not exceeding 3,750 volts alternating current to ground, or exceeding 750 volts, nominal, direct current to ground, excepting trolley contact wires.*
	A-3 Constant potential, alternating current, exceeding 7,500 volts between conductors when circuit is not grounded, or exceeding 3,750 volts to ground when circuit is grounded.
B	Constant potential, not exceeding 5,000 volts alternating current, when circuit is not grounded, or not exceeding 2,500 volts alternating current to ground when circuit is grounded, or not exceeding 750 volts, nominal, direct current to ground when circuit is grounded (excepting trolley contact wires*), and constant current series arc or incandescent lighting.

*Trolley feeders may be classed either with trolley contact wires of corresponding voltage or with other power circuits of the same voltage and character.

Sec. I.

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Class	Character and Operating Voltage
C	Communication, including telephone, telegraph and signal circuits not exceeding 750 volts, excepting those included in Class P .
D	<div data-bbox="194 357 267 487" style="display: inline-block; vertical-align: middle;"> $\left\{ \begin{array}{l} \text{D-1} \\ \text{D-2} \end{array} \right.$ </div> <div style="display: inline-block; vertical-align: middle;"> <p>Trolley contact wires not exceeding 2,500 volts alternating current, or not exceeding 750 volts, nominal, direct current.*</p> <p>Trolley contact wires exceeding 2,500 volts alternating current, or exceeding 750 volts, nominal, direct current.*</p> </div>
P	Telephone, telegraph or other signal wires not exceeding 750 volts used by the owners or operators of Class A , Class B or Class D circuits, but not for the use of the public.

NOTE:—Where Class **P** circuits throughout are in conformity with the requirements of these specifications for Class **C** circuits, the Class **P** conductors in the crossing span shall be treated as Class **C**.

Where Class **P** circuits throughout are not in conformity with the requirements of these specifications for Class **C** circuits, the crossing span shall be so constructed that the degree of hazard shall not be materially increased due to the presence of Class **P** circuits.

121. Changes at Crossing. When the operating voltage of the power circuits at a crossing is to be changed, the construction at the crossing shall be changed, if necessary, to conform with these specifications.

*Trolley feeders may be classed either with trolley contact wires of corresponding voltage or with other power circuits of the same voltage and character.

SECTION II.

SPECIFICATIONS FOR THE CONSTRUCTION OF OVER-HEAD CROSSINGS OF LINES OF LOWER VOLTAGE.

SCOPE.

201. Scope. These specifications apply to crossings, as follows:

Class A-1 cross over	Class A-1, A-2, B, D.
Class A-2 " " "	A-1, A-2, B, D.
Class B " " "	A-1, A-2, B, C, D.
Class C " " "	B, C, D-1 (not over D-2).
Class D " " "	D.

It is not intended that this section apply to cases where Class B wires cross over Class C and Class D-2 in the same span; crossings of this nature shall be constructed in accordance with Section III.

It is not intended that these specifications apply to crossings over or under individual twisted pair drop wires, service wires, or other circuits of minor importance, where equally effective protection may be secured more economically by other methods of construction.

202. Positions at Crossings. At crossings, conductors should generally be arranged in the order of the operating voltage, conductors of greatest voltage occupying the highest position, with the exception of trolley contact wires, which must necessarily occupy the lowest position, and trolley feeders which, for practical purposes, are generally run in approximately the same horizontal plane as the trolley contact wires to which they connect.

In crossing over trolley wires and feeders, or where it is impracticable to have the higher voltage wires above, the conductors occupying the upper position shall be considered, insofar as mechanical strength of construction is concerned, as included in the class of power circuits of the highest voltage below them.

Sec. II.

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203. Length of Span. The length of the crossing span should preferably not exceed 150 feet.

204. Clearance of Conductors. The vertical clearance, under normal conditions, between conductors of the crossing span and conductors of the span crossed, where carried on separate poles, shall not be less than two (2) feet for power conductors crossing other power conductors, and not less than four (4) feet for power conductors crossing over or under communication conductors.

- (a) The minimum clearance, as given above, shall be increased by two (2) inches for each ten (10) feet in excess of fifty (50) feet of the total distance obtained by adding together the distance from the point of crossing to the nearest pole supporting the crossing span, and the distance from the point of crossing to the nearest pole supporting the span crossed.
- (b) Where conductors of Class **C** only are involved, and there are no conductors of any other class in either crossing span or span crossed, the minimum vertical clearance shall be two (2) feet. Where cables or twisted pair wires, only, are used on one or both of the two lines, this clearance may be reduced to one (1) foot.
- (c) Where conductors of Class **D** are involved, the conductors of the crossing span shall be sufficiently raised above Class **D** wires, or otherwise protected to guard against damage from contact with trolley poles which may leave the trolley contact wire.
- (d) As trolley contact wires of necessity cross at the same level, arrangements must be made to provide an insulating cross-over, unless a conducting cross-over is agreed to by all the parties in interest.

205. Clearance of Poles. The poles of the line making a crossing shall be so located that no interference with the existing lines, or with the free use of the poles of either line, shall result.

206. Spacing of Conductors. The minimum separation in any direction, at the points of support, for power conductors or trolley feeders carrying a difference of potential, when supported on pin type insulators, shall be one (1) inch for each twenty (20) feet of span and one (1) inch additional for each foot of normal sag; but in no case shall the separation be less than twelve (12) inches, except that trolley feeders and ground returns 4/0 or larger, from 0-750 volts, may have a minimum separation of not less than six (6) inches, and signal wires may have a minimum separation of six (6) inches, which may be still further reduced at transpositions.

Where supported by insulators of the disc or suspension type, the minimum separation of conductors figured as above shall be increased by twenty-five (25) per cent., unless dead-ended or otherwise prevented from swinging.

The separation between conductors with voltages less than 750, carried on secondary racks bolted to the pole, may be not less than three (3) inches.

NOTE:—The separations specified in this paragraph do not apply to pole wiring.

207. Climbing Space. Power conductors of all classes shall be so installed as to provide a clear climbing space adjacent to the pole to which they are attached of not less than thirty (30) inches. This climbing space may be entirely on one side of the pole where necessary due to the use of cables or secondary rack construction carried on the other side of the pole. Conductors of communication circuits, where installed below power conductors and attached to the same pole, shall be so installed as to provide a similar climbing space.

208. Conductors. Conductors shall be of copper, copper-covered steel, aluminum, galvanized steel or other corrosion-resisting material.

209. Size of Conductors. Copper conductors of the crossing span shall not be smaller than the sizes given in the following table:

Sec. II.

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CLASS OF CONDUCTORS INVOLVED	SIZE OF WIRE—AMERICAN WIRE GAUGE			
	Line Spans Soft Drawn	Hard Drawn	Service Spans Soft Drawn	Hard Drawn
A	6	..	..	..
B	6	10	8	14
C	..	14	..	14

NOTE:—In using the above table, the highest voltage of any conductor, in either the crossing span or the span crossed, shall be used in order to determine the class of conductors involved.

No twisted pair wire of smaller conductor size than No. 14 A. W. G. copper or No. 17 A. W. G. copper-covered steel, or its equivalent in strength, shall be used in the crossing span.

Conductors of material other than copper, and messenger wires, shall be of such size and so erected as to have a mechanical strength not less than that of the sizes of copper conductors given above; but in no case shall the tensile strength of messenger wire, carrying cable or twisted pair wires, be less than 2,300 pounds.

210. Sag of Conductors. At crossings where power circuits are involved, conductors of the crossing span shall be strung with sags not less than shown in the tables given in Appendix A.

NOTE:—Where conductors of Class C only are involved, and there are no conductors of any other class in either crossing span or span crossed, the provisions of this paragraph do not apply.

211. Conductor Fastenings. Insulators, pins and conductor fastenings shall provide mechanical strength not less than the tension in the conductors supported, except where this is greater than 1,000 pounds, when the strength shall be at least 1,000 pounds.

212. Crossarms. Wooden crossarms carrying the crossing span shall be of long-leaf yellow pine, fir or other suitable timber and shall have a minimum section of three (3) inches by four and one-quarter ($4\frac{1}{4}$) inches. Galvanized or painted iron, or steel crossarms, of equal strength may be used.

213. Crossarms carrying the crossing span shall be attached to the poles with through bolts and shall be equipped with suitable galvanized iron braces.

214. **Gain Spacing.** The standard gain spacing between cross-arms (buck-arms excepted), shall be twenty-four (24) inches.

215. **Galvanizing.** Galvanized material shall meet the requirements specified by the National Electric Light Association or other standard generally sanctioned by good modern practice.

Sherardizing of small parts is permitted.

All holes in galvanized material shall be made before galvanizing.

216. **Poles.** Wooden poles supporting the crossing span shall be of chestnut or other selected timber, and shall be sound and reasonably straight.

Iron, steel or reinforced concrete poles, of adequate strength, may be used.

(For specifications for wooden poles, see Appendix B).

217. **Permissible Pole Loading.** Wooden poles supporting the crossing span shall carry not more than the number of No. 4 weather-proof wires specified in the tables in Appendix L or an equivalent load, excepting when the poles are guyed in accordance with Paragraph 220.

218. **Pole Setting.** Poles supporting the crossing span shall be set in ground to depths not less than those shown in the following tabulation:

Total Length of Pole (Feet)	Depth in Earth (Feet)
20	4.0
25	5.0
30	5.0
35	5.5
40	6.0
45	6.5
50	6.5
55	7.0
60	7.5
65	8.0
70	8.0
75	8.5
80	8.5

When the poles are set in rock, the depth of the setting may be decreased depending upon its character, but this depth shall never be less than three and one-half ($3\frac{1}{2}$) feet.

219. Identification. For the purpose of identification, poles or structures supporting the crossing span shall be clearly marked with the name, initials, or trade-mark of the owner of the structure.

220. Guying. The line of which the crossing span is a part shall be guyed according to the best modern practice.

Where head guys are installed on poles supporting the crossing span, they shall be so installed as not to increase appreciably the stress in the conductors of the crossing span.

The tensile strength of guys shall not be less than 2,300 pounds.

Poles supporting the crossing span shall be side and head-guyed when the loads are in excess of those specified in Paragraph 217.

The number and arrangement of guys shall be determined by the conditions existing at the crossing. Braces may be used instead of guys. Where poles, not self-supporting, are guyed, they become rigid structures acting only as struts, and the horizontal component of the load will be considered as taken entirely by the guys.

221. Clearance of Guys. The clearance between guy wires of one line and conductors of another line shall, where practicable, be not less than three (3) feet.

222. Guy Anchorage. Guys to ground shall be connected to a well anchored rod of such length that the eye of the rod shall be above the surface of the ground. Rods with a diameter of less than one (1) inch shall be galvanized.

223. Guy anchors shall, where practicable, be placed at a horizontal distance from the poles they reinforce, measured at the ground line, of not less than one-third ($1/3$) of the height of the point of attachment of the guy to the pole.

224. **Guy Strain Insulators.** Strain insulators shall be placed in all guys in the proximity of crossings where power circuits are involved, or these guys shall be permanently and effectually grounded. Strain insulators, in general, shall be placed not less than six (6) feet below the lowest conductor, not less than eight (8) feet above the ground, and, where practicable, not less than six (6) feet in a horizontal direction from the pole. Where it is impracticable to comply with the provisions of Paragraph 221, strain insulators shall be so placed as to protect pedestrians and men working on either line.

Strain insulators, when used in guys, shall meet the following mechanical and electrical requirements:

- (a) Strain insulators shall be capable of withstanding the maximum mechanical stress to which the guy of which they are a part may be subjected.
- (b) Strain insulators installed in guys shall be capable of withstanding, without puncture or flash-over, the maximum line voltage carried on either pole to which the guy is attached.

225. **Other Construction Requirements.** Construction requirements for all crossings, where not covered by these specifications, shall be according to the best modern practice.

226. For cause shown, in special cases, the Commission may afford relief from the operation of these Regulations to any particular public utility when public convenience and safety will not be injuriously affected thereby, and the welfare of such public utility will be subserved by modifications of any of the foregoing Regulations and Specifications.

SECTION III.

SPECIFICATIONS FOR THE CONSTRUCTION OF OVERHEAD CROSSINGS OF LINES OF HIGHER VOLTAGE.

SCOPE.

301. These specifications apply to crossings as follows:

- (a) All Class A-3 crossing spans;
- (b) Class A over Class C;
- (c) Class A or Class B over Class A-3;
- (d) In respect to mechanical requirements Class C over Class A or Class D-2;
- (e) Class B over Class C and Class D-2 in the same span.

It is not intended that these specifications apply to crossings over individual twisted pair drop wires, service wires, or other circuits of minor importance where equally effective protection may be secured more economically by other methods of construction.

GENERAL.

302. **Positions at Crossings.** At crossings, conductors should generally be arranged in the order of the operating voltage, conductors of greatest voltage occupying the highest position, with the exception of trolley contact wires, which must necessarily occupy the lowest position, and trolley feeders which, for practical purposes, are generally run in approximately the same horizontal plane as the trolley contact wires to which they connect.

In crossing over trolley wires and feeders, or where it is impracticable to have the higher voltage wires above, the conductors occupying the upper position shall be considered, insofar as mechanical strength of construction is concerned, as included in the class of power circuits of the highest voltage below them.

303. Location of Poles. The poles or towers supporting the crossing span and the next adjoining spans, where practicable, shall be located in a straight line.

304. Falling Trees. The crossing span and the next adjoining spans, so far as practicable, shall be kept free from trees which might fall into the line.

305. Fire Hazard. The poles or towers of the crossing span, so far as practicable, shall be located away from inflammable material or structures.

306. Length of Span. The length of the crossing span, where practicable, shall be not greater than the normal span of the line, and the length of the next adjoining span, where practicable, shall be not greater than one and one-half ($1\frac{1}{2}$) times the length of the normal span.

CLEARANCES.

307. Overhead Clearance. The vertical clearance between conductors of the crossing span and conductors of the span crossed, where carried on separate poles, shall be, under normal conditions (sixty (60) degrees Fahrenheit, and no wind or ice loading), not less than the sum of the values of (a) and (b) determined as below, but in no case where voltage is more than 7,500, less than six (6) feet.

- (a) One-tenth ($1/10$) of a foot for each kilo-volt, with a minimum value of four (4) feet.
- (b) Two (2) inches for each ten (~~10~~) feet of the total distance obtained by adding together the distance from the point of crossing to the nearest pole supporting the crossing span, and the distance from the point of crossing to the nearest pole supporting the span crossed.

NOTE:—Where conductors of Class D-2 are involved, the conductors of the crossing span shall be sufficiently raised above Class D-2 wires, or otherwise protected to guard against damage from contact with trolley poles which may leave the trolley contact wires.

308. Clearance of Poles. The poles of the line making a crossing shall be so located that no interference with the existing lines, or with the free use of the poles of either line, shall result.

309. Clearance of Guys. The clearance, under normal conditions, between conductors of one line and guy wires of another line, where practicable, shall be not less than one-tenth ($1/10$) foot for each kilo-volt with a minimum of four (4) feet.

310. Spacing of Conductors. The minimum separation in any direction, at the points of support, for power conductors carrying a difference of potential and supported on pin type insulators, shall be one (1) inch for each twenty (20) feet of span, and one (1) inch additional for each foot of normal sag, but in no case shall the separation be less than that shown in the following table:

VOLTAGE BETWEEN CONDUCTORS		Separation
Exceeding	Not Exceeding	
	7,000	12 in
7,000	14,000	20 in.
14,000	27,000	30 in.
27,000	35,000	36 in.
35,000	47,000	45 in.
47,000	70,000	60 in.
70,000		60 in. plus 0.6 in. per k.v. in excess of 70.

Where supported by insulators of the disc or suspension type, the minimum separation of conductors shall be increased by twenty-five (25) per cent., unless dead-ended or otherwise prevented from swinging.

NOTE:—The separations specified in this paragraph do not apply to pole wiring.

311. Clearance between Conductors and Supports. Clearance between any power conductor, or live hardware, and any portion of the supporting structure (insulator pins not included) shall not be less than three (3) inches, plus twenty-five one-hundredths (0.25) of an inch for each kilo-volt in excess of seven (7). For conductors supported by suspension or disc

type insulators and not dead ended at the pole structure, or otherwise prevented from swinging, clearance as above shall be figured on the assumption that the maximum deflection of the supporting insulators is forty-five (45) degrees from the vertical.

312. Gain Spacing. In no case shall the gain spacing between crossarms (buck arms excepted) be less than twenty-four (24) inches.

CONDUCTORS.

313. Material of Conductors. Conductors shall be of copper, copper-covered steel, aluminum, galvanized steel, or other corrosion resisting material, provided, however, that galvanized steel shall not be used in localities subject to excessive coal gases, or other conditions which would cause unusual corrosion.

314. Size of Conductors. The minimum allowable sizes for conductors of the crossing and adjoining spans are as follows:

Copper or Copper-covered Steel

Spans less than 150 feet. No. 6 Am. Wire Gauge

Spans 150 feet and over No. 4 " " "

Aluminum No. 1 " " "

Galvanized Steel 5/16 inch diameter

315. All aluminum and galvanized steel conductors shall be stranded.

NOTE:—The information available at present is not sufficient to show conclusively the relative reliability of stranded and solid copper conductors. Information is being collected on this subject and, until these data are available, no requirement as to the use of stranded or solid copper conductors is considered advisable.

316. Sag of Conductors. Conductors of the crossing and adjoining spans shall be strung with at least such sags as to withstand, with the designated factor of safety (Paragraph 359), the stresses due to the specified loading (Paragraph 356). See Appendix C for table of sags.

317. Splices in Conductors. The conductors in the crossing span shall be free from splices or taps. If a splice or tap is employed in any conductor in the next adjoining span, it shall be placed at a point nearer the crossing support than the distance from the crossing support of that conductor to the nearest wire crossed.

NOTE:—Where crossing is made under existing wires, the above requirement regarding splices may be waived with the consent of all parties in interest.

LIGHTNING PROTECTION WIRES.

318. Lightning Protection Wires. Lightning protection wires or cables, if used, shall conform to the requirements of specifications for conductors (Paragraphs 313, 314, 315, 316 and 317). When such wires are not connected to thoroughly grounded steel structures, they shall be permanently connected to ground, at each crossing pole or tower, by a wire with a conductivity not less than No. 4 A. W. G. copper. The ground wire shall be connected directly to the lightning protection wire and to a well-made ground, and the course of this ground connection shall be as straight as possible.

INSULATORS.

319. Material of Insulators. Insulators on power lines shall be of porcelain, or other material, which can be shown, to the satisfaction of the parties in interest, to be equally good in respect to mechanical and electrical requirements and durability.

320. Design of Insulators. Insulators shall be so designed that their dry flash-over is not more than seventy-five (75) per cent. of their puncture voltage, at a frequency of sixty (60) cycles.

321. Factor of Safety of Insulators. Insulators supporting the crossing and adjoining spans shall be capable of withstanding, without flash-over, at a frequency of sixty (60) cycles, the normal circuit voltage multiplied by the following factors:

VOLTAGE OF CIRCUIT		FACTOR	
Exceeding	Not Exceeding	Dry	Wet
	9,000	6.0	4.0
9,000	14,000	5.3	3.5
14,000	27,000	4.5	3.0
27,000	35,000	3.9	2.6
35,000	47,000	3.6	2.4
47,000	60,000	3.3	2.2
60,000		3.0	2.0

By the term "wet" is meant a condition equivalent to a precipitation of one-fifth ($1/5$) inch of rain per minute at an angle of forty-five (45) degrees to the axis of the insulator.

322. Tests. Each completed pin type insulator for line voltages over 15,000, and each completed suspension insulator disc, shall be subjected to a routine factory test at dry flash-over voltage, at a frequency of sixty (60) cycles for five (5) consecutive minutes, or any other test which may be generally sanctioned by good modern practice.

323. Voltage Measurements. Test voltages shall be determined by methods conforming to the standards of the American Institute of Electrical Engineers.

324. Strain Insulators. Strain insulators, when used in guys, shall meet the following mechanical and electrical requirements:

- (a) Strain insulators shall be capable of withstanding the maximum mechanical stress to which the guy of which they are a part may be subjected, with the factors of safety given in Paragraph 359.
- (b) Strain insulators installed in guys shall be capable of withstanding, without puncture or flash-over, twice the maximum line voltage carried on either pole to which the guy is attached.

CONDUCTOR ATTACHMENTS.

325. Pins. Insulator pins shall be of steel, wrought iron or malleable iron, and shall be galvanized. Cast-iron pin bases may be used. Pins of locust wood may be used, provided con-

ditions are such that digestion or rapid deterioration of wood pins does not occur.

326. Strength of Pins, Insulators and Fastenings. Insulators, pins and conductor fastenings (including clamps, ties and dead ends), carrying the crossing span, shall be designed:

- (a) To withstand, with the designated factors of safety (Paragraph 359), the stresses produced by the conductor under the specified loading (Paragraph 356).
- (b) To withstand, with the designated factors of safety (Paragraph 359), the stress due to the pull in one direction of the conductor supported,—the pull being taken as the tension in the conductor due to the specified load (Paragraph 356).

A longitudinal movement of the conductor will be permitted, provided this movement will not reduce the designated clearance at the point of crossing (Paragraph 307) by more than twenty-five (25) per cent. In the calculation of stress, no allowance shall be made for deformation, deflection or displacement of any part of the structure.

Method of Attaching Conductors to Insulators. When the stress in the conductor, under the specified loading (Paragraph 356,) does not exceed 2,000 pounds, the method of attaching conductors to double pin type insulators by tie wires, as shown in Appendix D, Figure 1, may be used to meet the requirements of this paragraph.

When the stress in the conductor, under the specified loading (Paragraph 356), exceeds 2,000 pounds, or when conditions are such that suspension or disc type insulators are desirable, a method of attaching conductors, satisfactory to all parties in interest, shall be used.

For suggested methods, see Appendix D.

327. Special Protection at Insulator. Where metal pins are used at either of the two crossing supports, or where wood pins are used and the crossarms are grounded (wood pins and non-grounded construction being generally used in other parts of

the line), the insulators used on such metal or grounded supports shall have an electrical factor of safety fifty (50) per cent. greater than at other parts of the line, but in no case less than as specified in Paragraph 321.

As an alternative, the conductors, at their points of attachment to the insulators at the crossing span, may be protected by arcing shields as shown in Appendix D.

NOTE:—The purpose of the foregoing requirements, described in Paragraphs 326 and 327, is to guard against the failure of the construction due to any of the following accidental conditions:

I. Mechanical Failures.

- (a) Failure due to the stresses produced by the conductors under the specified loading (Paragraph 356).
- (b) Failure due to unbalanced stresses in conductors, resulting from conductor, insulator, pin, or conductor fastening failing at the adjoining pole or tower.
- (c) Failure due to a broken or damaged insulator.

II. Electrical Failures.

- (a) Burning, by arcs or leakage current due to the failure of an insulator, pin, or conductor fastening, of any wooden part of the supporting structure which, if burned, would render the conductor liable to fall.
- (b) Burning or weakening of the conductor, at the insulator, due to arcs or leakage current.

Other methods of guarding against these accidental conditions may be used, if agreed upon by the parties in interest, as being equally effective as the methods herein described.

CROSSARMS.

328. Crossarms. The crossarms carrying the crossing span shall be of at least the following dimensions:

- (a) Wood crossarm— $3\frac{1}{2}$ in. x $4\frac{1}{2}$ in.
- (b) Steel “ —3 in. x 3 in. x 5/16 in.

329. Crossarms carrying the crossing span shall be attached to the poles with through bolts and shall be equipped with suitable galvanized iron braces. Double crossarms shall be fitted with spacing bolts, equipped with spacing nuts and washers, pipe spacers, or similar construction, or with spacing blocks or plates.

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330. Strength of Crossarms. The crossarms carrying the crossing span, including their fastenings to the poles or towers, shall be designed:

- (a) To withstand, with the designated factors of safety (Paragraph 359), the stresses produced by the conductors under the specified loading (Paragraph 356).
- (b) To withstand, at all times without failure, the unbalanced stress due to the combined pull in one direction of all the conductors supported,—the pull of each conductor being taken as the tension in the conductor due to the specified load (Paragraph 356).

In the calculation of stress, no allowance shall be made for the deformation, deflection or displacement of any part of the structure.

For method of figuring strength of double crossarms, see Appendix E.

SUPPORTING STRUCTURES.

331. Wooden Poles. Wooden poles supporting the crossing span shall be of chestnut or other selected timber, reasonably straight, peeled, free from defects which decrease their strength or durability, and not less than twenty-two (22) inches in circumference at the top.

332. Steel Towers. Steel for structures supporting the crossing span shall conform to the "Specifications for Structural Steel for Buildings," as adopted by the American Society for Testing Materials.

333. Design and workmanship shall be in accordance with good modern practice.

334. The form of the frame shall be such that stresses may be computed with reasonable accuracy, or the strength of the structure shall be determined by actual test.

335. Construction shall be such that all parts are accessible for inspection, cleaning and painting, and shall not permit of pockets in which water or dirt might collect.

336. The unsupported length of a tower leg shall not exceed 140 times its least radius of gyration.

The unsupported length of a secondary compression member, having figured stress, shall not exceed 180 times its least radius of gyration.

The unsupported length of a compression member, placed to reduce the unsupported length of a leg or secondary member (therefore having no figured stress), shall not exceed 200 times its least radius of gyration.

337. The minimum thickness of metal in galvanized structures shall be one-quarter ($\frac{1}{4}$) inch for main members and three-sixteenths ($\frac{3}{16}$) inch for all other members. The minimum thickness of metal in painted structures shall be one-quarter ($\frac{1}{4}$) inch.

338. **Strength of Supporting Structures.** The poles or towers supporting the crossing span shall be designed:

- (a) To withstand, with the designated factor of safety (Paragraph 359), the combined stresses produced by their own weight, the specified wind pressure on the poles or towers (Paragraph 357), and the specified conductor loading (Paragraph 356) on all conductors supported in both the crossing span and the next adjoining span.
- (b) To withstand, at all times without failure, the unbalanced stress due to the combined pull in the direction of the crossing of all the conductors supported,—the pull of each conductor being taken as the tension in the conductor due to the specified load (Paragraph 356).

NOTE:—In designing steel towers, to withstand this unbalanced stress, the maximum allowable unit fibre stress shall be:

For tension members: 24,000 lbs. per square inch.

For compression members: $24,000 - \frac{60L}{R}$ lbs. per square inch.

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In the case of wooden or steel poles, when head guys are used to meet this requirement, this unbalanced stress may be assumed to be distributed equally over one or more poles adjoining the crossing, provided all the construction between the crossing span and any such poles is in conformity with these specifications.

In the calculation of stress, no allowance shall be made for the deformation, deflection or displacement of any part of the structure.

339. In the case of wooden pole construction, where the requirements of Paragraph 338 (a) cannot be met except by the use of side guys or special structures, and it is physically impracticable to employ side guys at the crossing poles, the requirements of Paragraph 338 (a) may be met by side-guying the line as near as practicable to the crossing but at a distance not exceeding 500 feet from the point of crossing, provided:

- (a) The side-guyed poles shall be designed to withstand the stress due to wind and ice loading transversely to the line, on the assumption that the whole transverse strain of the line, between the poles so side-guyed, is carried by them.
- (b) The line between such guyed poles and the crossing shall be substantially in a straight line with the crossing poles.
- (c) The average length of span between the guyed poles and the crossing shall not be in excess of 150 feet.

When these conditions are met, and the crossing line between the guyed poles is otherwise constructed in accordance with these specifications, then, for the intervening poles, considered individually, without reinforcement from adjoining poles, the requirements of Paragraph 338 (a) may be modified to the extent of reducing the specified factor of safety, depending upon the number of wires carried, as per the following table:

Number of Wires	Factor of Safety
4	4.0
6	3.5
12	2.0
18	1.4
24 or more	1.0

340. Pole Setting. Poles shall be set in the ground to depths not less than those shown in the following tabulation:

Total Length of Pole (Feet)	Depth in Earth (Feet)
25	5.5
30	6.0
35	6.0
40	6.5
45	7.0
50	7.0
55	7.5
60	7.5
65	8.0
70	8.0
75	8.5
80	8.5

When poles are set in rock, the depth of the setting may be decreased, depending upon its character, but this depth shall never be less than four (4) feet.

341. Where located in soft or swampy ground, the setting of poles shall be suitably reinforced. This may be done by setting in barrels of broken stone or gravel, or in stone or timber footings, or by any other equally effective method.

342. Where located in the sides of banks, or where subject to washouts, foundations or pole settings shall be given additional depth, or be protected by cribbing or riprap.

343. Backfillings for foundations or pole settings shall be carefully tamped, or otherwise thoroughly compacted, while being placed.

344. Foundations for Steel Towers. Foundations for towers supporting the crossing span shall be adequate to withstand, with the designated factor of safety (Paragraph 359), the maximum stress to which they will be subjected when wires and structures are loaded in accordance with Paragraphs 338, 356 and 357.

345. In designing foundations for towers, the weight of concrete shall be considered as 140 pounds per cubic foot. The weight of "earth" (calculated at thirty (30) degrees from the vertical) shall be considered, in good ground, as 100 pounds per cubic foot. In swampy ground, special measures shall be taken to prevent uplift or depression.

346. The top of a concrete foundation, or casing, shall extend at least six (6) inches above the surface of the ground, except when pavements or sidewalks make this impracticable, and shall have sufficient slope to prevent collection of water.

347. Identification. For the purpose of identification, poles or structures supporting the crossing span shall be clearly marked with the name, initials, or trade-mark of the owner of the structure.

GUYS.

348. Use of Guys. Guys may be used in meeting the specified strength requirements for supports (Paragraph 338). The number and arrangement of guys shall be determined by the conditions existing at the crossing. Braces may be used instead of guys. Where head guys are installed on poles supporting the crossing span, they shall be so installed as not to increase appreciably the stress in the conductors of the crossing span.

349. Where poles, not self-supporting, are guyed, they become rigid structures acting only as struts, and the horizontal component of the load will be considered as taken entirely by the guys. Where steel structures, not self-supporting, are guyed, they act as struts and also as beams. In figuring the strength of such structures and their guys, the structures con-

sidered alone, may be figured as carrying such portion of the horizontal component of the load, together with the vertical component of the load acting on the structure as a strut, as will not stress any part of the structure beyond the designated factor of safety (Paragraph 359). The remaining portion of the horizontal component of the load shall be figured as carried by the guys with the designated factor of safety (Paragraph 359).

350. Material. Guys shall be galvanized or copper covered stranded steel cable, or rolled rods, and must have a minimum nominal diameter of five-sixteenths ($5/16$) inch.

351. Anchorage. Guys to ground shall be connected to a well-anchored rod of such length that the eye of the rod shall be above the surface of the ground. Rods with a diameter of less than one (1) inch shall be galvanized.

352. Guy anchors shall, when practicable, be placed at a horizontal distance from the poles they reinforce, measured at the ground line, of not less than one-third ($1/3$) of the height of the point of attachment of the guy to the pole.

353. Guy Stubs. Guy stubs, or poles used as guy stubs, with their foundations, anchorages and reinforcements, shall be adequate to withstand, with the designated factor of safety (Paragraph 359), the maximum stress to which they will be subjected when wires and structures are loaded in accordance with Paragraphs 338, 356 and 357.

354. Strain Insulators. A strain insulator, when used, shall conform to requirements of Paragraph 324, and in general shall be placed not less than six (6) feet below the lowest conductor, not less than eight (8) feet above the ground, and, where practicable, not less than six (6) feet, in a horizontal direction from the pole. When it is impracticable to comply with the provisions of Paragraph 309, strain insulators shall be so placed as to protect pedestrians and men working on either line. Guys not equipped with strain insulators shall be permanently and effectually grounded.

PROTECTIVE COATINGS.

355. Protective Coatings on Steel. All structural steel shall be thoroughly cleaned at the shop, and shall be galvanized or painted, as follows:

- (a) **Painting.** Painting shall consist of one (1) complete shop coat, one (1) field coat on all contact surfaces before assembling, and one (1) complete field coat after assembling. Before painting in the field, the surface of the metal shall again be thoroughly cleaned of all dirt, grease, etc., and worn or defaced spots shall be touched up. No painting shall be done in freezing or rainy weather.
- (b) **Galvanizing.** Galvanized material shall meet the requirements specified by the National Electric Light Association, or other standard generally sanctioned by good modern practice.
Sherardizing of small parts is permitted.
All holes in galvanized material shall be made before galvanizing.

LOADS.

356. Loads. The conductors shall be considered as loaded uniformly throughout their length with a load equivalent to the resultant of the dead load, the weight of a layer of ice one-half ($\frac{1}{2}$) inch in thickness, and a wind pressure of eight (8) pounds per square foot of ice-covered diameter, at a temperature of zero (0) degrees Fahrenheit. The weight of the ice shall be assumed as fifty-seven (57) pounds per cubic foot (0.033 pounds per cubic inch).

357. The supporting structures shall be considered as subjected to a wind pressure of:—

- (a) Eight (8) pounds per square foot on the projected area of cylindrical surfaces, such as wood or tubular steel poles.
- (b) Thirteen (13) pounds per square foot on the projected area of flat surfaces, such as crossarms, etc.

- (c) Thirteen (13) pounds per square foot on twice the projected area of one of two parallel faces of latticed or trussed structures.

The areas above enumerated shall be considered as increased by one-half ($\frac{1}{2}$) inch of ice on all the exposed surface.

358. Temperatures. Computation of stresses due to the temperature load shall be based upon an assumed temperature of minus twenty (-20) degrees Fahrenheit.

GENERAL REQUIREMENTS.

359. Mechanical Factors of Safety. In design and construction the ultimate unit strength divided by the allowable working unit stress shall be not less than the values shown in the following tabulation:

Wires, cables and conductor attachments,	2
Pins,	2
Pole line hardware,	2
Line insulators (mechanical),	3
Guy insulators—non-interlocking,	3
Guy insulators—interlocking,	2
Guys,	3
Wooden poles,	4
Wooden crossarms,	4
Structural steel poles, towers and crossarms,	3
Reinforced concrete poles and crossarms,	4
Foundations and anchorages,	2

Allowable working unit stresses, as given in Appendix F, are derived by dividing generally approved ultimate unit strengths by the factors of safety shown above.

360. Other Construction Requirements. Construction requirements for all crossings, where not covered by these specifications, shall be according to the best modern practice.

ALTERNATE TYPES OF CONSTRUCTION.

361. The following describes methods of construction which offer alternatives to some of the foregoing requirements. Un-

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less specifically excepted all the foregoing requirements will apply to these types of construction.

362. Short Span Method. This method consists in making a short span at such a height that the radial distance, from the lowest insulators of the crossing span to the nearest wires of the span crossed, is greater than the length of the crossing span.

Conductors not meeting the requirements of Paragraphs 313 to 317, inclusive, may be used, provided a grounded guard arm is placed on each of the crossing poles or towers in such a manner as to prevent the upper wires in the next adjoining spans from whipping back into the wires crossed in case of failure of the upper wires. The requirements which may be omitted when this construction is used are Paragraphs 306, 313 to 317, inclusive, and 319 to 323, inclusive.

If conductors, which meet the requirements of Paragraphs 313 to 317, inclusive, are used, and the next adjoining spans to the crossing are not less in length than twice the height above ground of the highest wire of the crossing spans, the grounded guard arms may be omitted.

To avoid the necessity for poles or towers of excessive height, as supports for the crossing span:

- (a) The line crossed shall be built as low as possible.
- (b) On Class C lines so crossed, the horizontal distance between conductors may be reduced to permit the crossing poles or towers to be placed nearer together.

See Appendix G.

363. Use of Cable. The Class A wires may be carried in aerial, armored, or metal sheath cable, in which case the requirements of the following paragraphs may be omitted:

307, 310 to 312, inclusive
319 to 323, inclusive
325, 326 and 327.

The vertical clearance from the cable to any conductor of the span crossed shall be not less than forty (40) inches.

The provisions of Paragraphs 313, 314, 315, 316 and 317 shall apply to the supporting messenger wire, but not to the cable or cable conductors.

The provisions of Paragraphs 328, 329 and 330 shall apply where cable is suspended from crossarms and not otherwise.

The messenger and armor or metal sheath of the cable shall be permanently and effectually grounded. The cable shall extend at least one span on each side of the crossing. The cable shall be capable of withstanding at least twice the normal line voltage between any two conductors, or between any conductor and the sheath or armor.

364. For cause shown, in special cases, the Commission may afford relief from the operation of these Regulations to any particular public utility when public convenience and safety will not be injuriously affected thereby, and the welfare of such public utility will be subserved by modifications of any of the foregoing Regulations and Specifications.

SECTION IV.

SPECIFICATIONS FOR COLLINEAR CONSTRUCTION
OF OVERHEAD LINES.

401. Definition. The term "conflicting construction" shall be understood to mean a situation where a line is built over, under, or alongside another line, on separate supports (crossings at an angle of fifteen (15) degrees or over excepted) within such distance that failure of the supports or attachments of one line might result in contact with the attachments of the other line. When the conflicting lines are so situated that one line is wholly or partly over the other line, the construction will be designated as "collinear."

402. Scope. While the scope of these specifications does not include provisions covering conflicting lines generally, it does include collinear construction, and, as Sections II and III are primarily confined to angle crossings, the requirements pertaining to collinear lines are given below.

403. Notice of Construction. So far as practicable, collinear construction shall be avoided except where joint construction is employed. No company shall construct a line collinear with any existing line without first giving the owner of the existing line notice, in writing, sufficiently in advance to afford opportunity for consideration by the interested companies of means for avoiding the collinear condition.

404. Conditions. When conditions are such that avoidance of collinear construction is impracticable, the line may be built subject to the following conditions:

- (a) In case of collinear construction between Class B and Class C lines, Class B lines shall, where possible, occupy the upper position and shall conform to the requirements of Section II of these specifications, except as modified by the following:

- (i) The clearance between the top wire of the lower line and the bottom wire of the upper line shall not be less than forty (40) inches, plus two (2) inches for each ten (10) feet in length of the span of the upper line in excess of one hundred (100) feet.
- (ii) The construction of the line in the lower position shall be such as to afford a clear climbing space of at least thirty (30) inches.
- (b) In case of collinear construction between Class A and Class C lines, Class A lines shall, where possible, occupy the upper position and shall conform to the requirements of Section III, except as modified by the following:
 - (i) The wires of the upper line may be spliced, but the ultimate strength of the splice shall be considered as ten (10) per cent. less than the average tested strength of the type of splice used.
 - (ii) The clearance between the top wire of the lower line and the bottom wire of the upper line shall not be less than six (6) feet under normal conditions.
 - (iii) The construction of the line in the lower position shall be such as to afford a clear climbing space of at least thirty (30) inches.
 - (iv) Lightning protection wires shall be grounded at least as frequently as in other portions of the line.
- (c) Where it is not possible for the Class A or Class B lines to occupy the upper position, the conductors occupying the upper position shall be considered, insofar as mechanical strength of construction is concerned, as included in the class of power circuits of the highest voltage below them.

405. For cause shown, in special cases, the Commission may afford relief from the operation of these Regulations to any particular public utility when public convenience and safety will not be injuriously affected thereby, and the welfare of such public utility will be subserved by modifications of any of the foregoing Regulations and Specifications.

SECTION V.

SPECIFICATIONS FOR THE CONSTRUCTION OF OVER-HEAD CROSSINGS OF COMMUNICATION LINES OVER RAILROADS.

SCOPE.

501. These specifications apply to crossings of Class **C** and Class **P** lines over tracks of railroads and their associated Class **C** or Class **P** wire lines in the same span. If Class **C** or Class **P** lines cross Class **A**, **B**, or **D** lines and railroad tracks in the same span, the Class **C** or Class **P** lines shall, where practicable, be below the Class **A**, **B** or **D** lines; however, if necessary for Class **C** or Class **P** lines to cross over railroad tracks, and Class **A**, **B** or **D** lines in the same span, the crossing, insofar as mechanical strength of construction is concerned, shall be in accordance with Section VI.

GENERAL.

502. **Location of Poles.** The poles supporting the crossing span and the next adjoining span, where practicable, shall be located in a straight line.

503. **Falling Trees.** The crossing span and the next adjoining spans, so far as practicable, shall be kept free from trees which might fall into the line.

504. **Fire Hazard.** The poles of the crossing span, so far as practicable, shall be located away from inflammable material or structures.

505. **Length of Span.** The length of the crossing span shall be as short as practicable, and in general shall not be greater than the normal span of the line. No crossing span should exceed 150 feet in length. The length of the next adjoining spans,

where practicable, shall be not greater than one and one-half ($1\frac{1}{2}$) times the length of the crossing span.

506. Grading. Whenever practicable, the difference in elevation of the wire supports, at the crossing poles and the poles next adjacent, shall not be greater than five (5) feet. It is desirable that this difference of elevation be less than five (5) feet.

CLEARANCES.

507. Clearance of Poles. Unless physical conditions or municipal requirements prevent, the side clearance between the poles of the crossing span and the nearest track rail shall not be less than twelve (12) feet, except that at sidings a clearance of not less than seven (7) feet may be allowed. At loading sidings sufficient space shall be left for a driveway.

508. The poles of the line making a crossing shall be so located that no interference with the existing lines, or with the free use of the poles, shall result.

509. Clearance Over Rails. The vertical clearance between the conductors of the crossing span and the top of the rail shall, under normal conditions (sixty (60) degrees Fahrenheit and no wind or ice loading), be not less than twenty-seven (27) feet.

510. Clearance Over Wires. The vertical clearance between conductors of the crossing span and conductors of the span crossed, where carried on separate poles, shall under normal conditions (sixty (60) degrees Fahrenheit and no wind or ice loading), be not less than four (4) feet.

511. Spacing of Conductors. The separation of conductors in the crossing span shall preferably be not less than twelve (12) inches, but in no case less than six (6) inches. Not more than ten (10) wires shall be supported by one set of double arms.

512. Vertical Spacing of Conductors. The vertical clearance between conductors supported on the same pole or structure shall preferably be twenty-four (24) inches, but in no case less than twelve (12) inches.

NOTE:—The requirements of Paragraphs 511 and 512 do not apply to conductors in cable or to twisted pair wires.

POLES.

513. Quality of Poles. Wooden poles supporting the crossing span shall be of chestnut, or other selected timber, and shall be sound and reasonably straight. They shall conform to the specifications for the proper class, as given in Appendix B. The several classes shall be used as follows:

- For poles carrying not over 20 wires—Class C poles;
- For poles carrying more than 20, and not more than 40, wires—Class B poles;
- For poles carrying more than 40, and not more than 80, wires—Class A poles.

514. Pole Settings or Foundations. Poles shall be set in the ground to depths not less than those shown in the following tabulation:

Length of Poles (Feet)	Depth in Earth (Feet)
20	5.0
22	5.0
25	5.5
30	5.5
35	6.0
40	6.5
45	7.0
50	7.0
55	7.5
60	7.5

515. Where the poles are set in rock the depth of setting may be decreased depending upon its character, but this depth shall be not less than four (4) feet. By "length of pole" is meant the total length of the pole and not the height of the pole above the ground.

516. Where located in soft or swampy ground the setting of poles shall be suitably reinforced. This may be done by setting in barrels of broken stone or gravel, or in stone or timber footings, or by any other equally effective method.

517. Where located in the sides of banks or where subject to washouts, foundations or pole settings shall be given additional depth or protected by cribbing or riprap.

518. Back fillings for foundations or pole settings shall be carefully tamped or otherwise thoroughly compacted while being placed.

519. **Identification.** For the purpose of identification poles shall be plainly marked with the name, initials or trade-mark of the owner of the poles.

GUYING.

520. **Guying Required.** The poles supporting the crossing span shall be head guyed away from the crossing span and side guyed in each direction. The number and size of guys shall be not less than given in the following table:

NUMBER OF WIRES IN CROSSING SPAN	NUMBER AND NOMINAL TENSILE STRENGTH OF GUYS	
	Head Guys	Side Guys (in each direction)
1 to 10 wires	1— 6,000 lb. strand	1— 6,000 lb. strand
11 " 20 "	1— 6,000 " "	1— 6,000 " "
21 " 30 "	1—10,000 " "	1— 6,000 " "
31 " 40 "	2— 6,000 " strands	1—10,000 " "
41 " 50 "	1—16,000 " strand	1—10,000 " "
51 " 60 "	2—10,000 " strands	1—16,000 " "
61 " 70 " }	1—16,000 " strand	
	1—10,000 " "	1—16,000 " "
71 " 80 "	2—16,000 " strands	2—10,000 " strands

521. **Location of Anchors.** Guy anchors shall, where possible, be located so that the horizontal distance from the ground line of the pole to the guy or guy rod will be not less than the height above ground of the attachment of the guy to the poles, for head guys, and not less than one-third ($1/3$) that height, for side guys. Where the anchor for the head guy is located nearer to the pole than this distance, the amount of guying shall be increased to provide equivalent strength.

522. A different arrangement and number of guys than specified in Paragraph 520 may be used provided equivalent strength is obtained.

523. **Location of Guy Attachments to Poles.** On poles carrying one or two crossarms both head and side guys shall be attached under the upper crossarms. On poles carrying more than two crossarms the first head guy shall be attached below the second crossarm and successive head guys under the fourth and sixth crossarms. On poles carrying more than two crossarms side guys shall be attached below the second crossarm.

524. **Alternative Method of Guying.** Where on account of physical conditions it is impracticable to guy the crossing poles as specified in Paragraph 520, the requirements of this paragraph may be met by head guying and side guying the line as near as practicable to the crossing, but at a distance not exceeding 500 feet from the nearest crossing pole, provided; that a strand of strength equivalent to the head guy is run between the two guyed poles, being attached to the guyed poles at the point at which the head guys are attached, this strand being securely attached to every pole between the guyed poles.

525. Where the poles supporting the crossing span are not in line with the poles in the adjoining spans, additional guying shall be placed to take care of the increased strain.

526. **Pole Braces.** Braces may be used instead of guys to obtain the reinforcement above specified.

527. **Material for Guys.** Guys shall be of galvanized or copper covered stranded steel cable or rolled rods and must have a minimum nominal diameter of five-sixteenths ($5/16$) inch.

528. **Anchorage.** Guys to ground shall be connected to an anchor rod of such length that the eye of the rod shall be above the surface of the ground. Rods with a diameter of less than one (1) inch shall be galvanized.

529. **Guy Stubs.** Guy stubs or poles may be used in place of anchors provided the same amount of reinforcement is obtained by their use.

530. Anchor Logs. Anchor logs for use with different sizes of guy strand shall be of the dimensions and shall be set to the depths given in the following table:

Nominal Tensile Strength of Guy Strand	Minimum Depth of Excavation	Minimum Length and Width of Round Logs	Minimum Length and Width of Split Logs
6,000 lb.	4 ft.	3 ft. x 6 in.	3 ft. x 8 in.
10,000 "	5 "	4 " x 7 "	4 " x 10 "
16,000 "	5 "	6 " x 8 "	6 " x 12 "

531. The above sizes of logs and depths of setting apply to soil of average compactness. In loose sandy soil the depth of setting or the length of the logs shall be adequately increased.

CROSSARMS.

532. Crossarms. Wooden crossarms carrying the crossing span shall be of long-leaf yellow pine, fir or other suitable timber and shall have a minimum section of three (3) inches by four and one-quarter ($4\frac{1}{4}$) inches. Galvanized or painted iron, or steel crossarms, of equal strength may be used.

533. Crossarms shall be double on the crossing poles and shall be held together with properly fitted spacing blocks or bolts placed immediately adjoining the outside pins. Both crossarms shall be properly fitted in gains and held in place by not less than one five-eighths ($\frac{5}{8}$) inch through bolt. Both arms shall be fitted with galvanized iron or steel braces not less than three-sixteenths ($\frac{3}{16}$) inch by one and three-sixteenths ($1\frac{3}{16}$) inches by twenty-six (26) inches long which shall be attached to the crossarms by a lag screw not less than two and one-quarter ($2\frac{1}{4}$) inches by three-eighths ($\frac{3}{8}$) inch or a carriage bolt not less than four (4) inches by three-eighths ($\frac{3}{8}$) inch and to the pole by a fether drive screw or lag screw not less than four (4) inches by one-half ($\frac{1}{2}$) inch or by not less than a one-half ($\frac{1}{2}$) inch through bolt.

PINS.

534. Pins. Insulator pins shall be of steel, wrought-iron, malleable iron, or locust wood. Locust pins shall be sound,

straight-grain locust, with a minimum diameter of shank of one and one-quarter ($1\frac{1}{4}$) inches and a maximum length of eight (8) inches. Steel or iron pins shall have a minimum diameter of shank of one half ($\frac{1}{2}$) inch and a maximum length of eight and three-quarter ($8\frac{3}{4}$) inches.

INSULATORS.

535. Insulators. Each insulator shall be of such pattern, design and material that when mounted it will withstand without injury or without being pulled off the pin, the ultimate strength of the conductor attached to the insulator.

CONDUCTORS.

536. Material of Conductors. Conductors shall be of copper, copper covered steel, galvanized steel, or other corrosive resisting metal, provided however, that galvanized steel shall not be used in localities subject to excessive coal gases or other conditions which would cause excessive corrosion.

537. Size of Conductors. The minimum allowable sizes for conductors of the crossing span and adjoining spans are as follows:

Copper.

Spans 125 ft. or less	No. 10 A. W. Gauge
" 126 ft to 150 ft.	No. 9 " "

Galvanized Steel.

Spans 125 ft. or less	No. 10 B. W. Gauge
" 126 ft to 150 ft.	No. 8 " "

If spans in excess of 150 feet are necessary, the size of conductor specified above shall be increased.

538. Conductors of material other than copper shall be of such size and so erected as to have a mechanical strength not less than that of the sizes of copper conductors given above.

539. The use of twisted pair wires without a messenger wire support shall be eliminated as far as practicable. In no case

shall this kind of wire be used in spans longer than one hundred (100) feet without a messenger wire support. Each wire of a twisted pair not supported by a messenger wire shall be tinned hard drawn copper not smaller than No. 14 A. W. Gauge or tinned copper covered steel not smaller than No. 17 A. W. Gauge.

540. Sag of Conductors. Conductors of the crossing span shall be strung with sags not less than shown in the tables given in Appendix A.

541. Splices in Conductors. The conductors in the crossing span shall be free from splices or taps.

542. Conductor Attachments. Each conductor shall be attached to its insulators by tie wires. Copper and steel wires shall be tied to the insulators in the manner shown in Appendix H. Tie wires for copper or copper covered steel wires shall be of the same gauge as the line wire and of soft copper or of hard drawn copper which has been thoroughly annealed. Tie wires for steel line wire shall be of soft iron or steel and of the same gauge as the line wire up to and including No. 9 B. W. Gauge. Tie wires for No. 8 B. W. Gauge steel line wire or larger shall not be smaller than No. 9 B. W. Gauge.

CABLES.

543. Strand for Supporting Cables. Galvanized steel strand cable having a breaking strength of not less than 6,000 pounds shall be used to support cable of fifty (50) pairs of No. 19 A. W. Gauge copper conductors or their equivalent and smaller; or not less than 10,000 pounds breaking strength for cables in excess thereof up to 100 pairs of No. 19 A. W. Gauge copper conductors or their equivalent; and not less than 16,000 pounds breaking strength for cables containing more than 100 pairs No. 19 A. W. Gauge copper conductors or their equivalent. Not more than two messenger wires for supporting cable shall be attached to either pole of the crossing span.

544. Sag of Strand Supporting Cables. Cables shall be suspended with a minimum sag as follows:

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Span in Feet	Minimum Sag in Inches
80 or less	16
90	20
100	22
110	26
120	30
130	34
140	40
150	44
175	62

545. **Attaching Cables to Messengers.** Cables shall be attached to messenger wire supports by means of galvanized metal rings or hangers, or marline, or marline hangers. The method of attachment shall be such as to develop the full strength of the messenger wire.

GALVANIZED MATERIAL.

546. **Galvanizing.** Galvanized material shall meet the requirements specified by the National Electric Light Association or other standards generally sanctioned by good modern practices.

Sherardizing of small parts is permitted.

All holes in galvanized material shall be made before galvanizing.

OTHER CONSTRUCTION REQUIREMENTS.

547. Auxiliary construction, such as guy attachments to poles, guy clamps, anchorages, etc., not definitely covered by these specifications, shall be of such design and strength as to develop the full strength of that member of which they are a part.

548. Construction requirements not covered by these specifications shall be according to the best modern practice.

549. For cause shown, in special cases, the Commission may afford relief from the operation of these Regulations to any particular public utility when public convenience and safety will not be injuriously affected thereby, and the welfare of such public utility will be subserved by modifications of any of the foregoing Regulations and Specifications.

SECTION VI.

SPECIFICATIONS FOR THE CONSTRUCTION OF OVER- HEAD CROSSINGS OF POWER LINES OVER RAILROADS.

SCOPE.

601. These specifications apply to crossings of Class A, B and D lines over tracks of railroads, and over their associated paralleling wire lines located on the same right-of-way; also in respect to mechanical strength of construction to crossings of Class C and Class P lines over railroad tracks and over Class A, B or D wires in the same span.

GENERAL.

602. **Position at Crossings.** At crossings, conductors should generally be arranged in the order of the operating voltage, conductors of greatest voltage occupying the highest position, with the exception of trolley contact wires, which must necessarily occupy the lowest position, and trolley feeders which, for practical purposes, are generally run in approximately the same horizontal plane as the trolley contact wires to which they connect.

In crossing over trolley wires and feeders, or where it is impracticable to have the higher voltage wires above, the conductors occupying the upper position shall be considered, insofar as mechanical strength of construction is concerned, as included in the class of power circuits of the highest voltage below them.

603. **Location of Poles.** The poles or towers supporting the crossing span and the next adjoining spans, where practicable, shall be located in a straight line.

604. **Falling Trees.** The crossing span and the next adjoining spans, so far as practicable, shall be kept free from trees which might fall into line.

605. **Fire Hazard.** The poles or towers of the crossing span, so far as practicable, shall be located away from inflammable material or structures.

606. **Length of Span.** The length of the crossing span, where practicable, shall be not greater than the normal span of the line, and the length of the next adjoining span, where practicable, shall be not greater than one and one-half ($1\frac{1}{2}$) times the length of the normal span.

CLEARANCES.

607. **Side Clearance.** Unless physical conditions or municipal requirements prevent, the side clearance between supports of the crossing span and the nearest track rail shall not be less than twelve (12) feet, except that at sidings a clearance of not less than seven (7) feet may be allowed. At loading sidings sufficient space shall be left for a driveway.

608. **Overhead Clearance from Rail.** The vertical clearance between the conductors of the crossing span and the top of the rail shall be, under normal conditions (sixty (60) degrees Fahrenheit and no wind or ice load), not less than the following:

- (a) Where the distance between the crossing supports does not exceed 150 feet, twenty-six (26) feet plus the minimum separation between conductors as tabulated in Paragraph 612.
- (b) Where the distance between the crossing supports exceeds 150 feet, clearance as specified in (a), above, shall be increased two (2) inches for each ten (10) feet in length of crossing span in excess of 150 feet.
- (c) Trolley contact wires and trolley feeders are excepted from the above. The minimum clearance for trolley contact wires shall be twenty-two (22) feet and for trolley feeders twenty-five (25) feet.

609. Overhead Clearance from Wire Lines. The vertical clearance between conductors of the crossing span and conductors of the associated paralleling wire lines of the railroad crossed, where carried on separate poles, shall be, under normal conditions (sixty (60) degrees Fahrenheit, and no wind or ice loading), not less than the sum of the values of (a) and (b) determined as below, but in no case, where voltage is more than 7,500, less than six (6) feet.

- (a) One-tenth ($1/10$) of a foot for each kilo-volt, with a minimum value of four (4) feet.
- (b) Two (2) inches for each ten (10) feet of the total distance obtained by adding together the distance from the point of crossing to the nearest pole supporting the crossing span, and the distance from the point of crossing to the nearest pole supporting the span crossed.

NOTE:—Where conductors of Class D-2 are involved, the conductors of the crossing span shall be sufficiently raised above Class D-2 wires, or otherwise protected to guard against damage from contact with trolley poles which may leave the trolley contact wires.

610. Clearance of Poles. The poles of the line making a crossing shall be so located that no interference with the existing lines, or with the free use of the poles of either line, shall result.

611. Clearance of Guys. The clearance, under normal conditions, between conductors of one line and guy wires of another line, where practicable, shall be not less than one-tenth ($1/10$) foot for each kilo-volt with a minimum of four (4) feet.

612. Spacing of Conductors. The minimum separation in any direction, at the points of support, for power conductors carrying a difference of potential and supported on pin type insulators, shall be one (1) inch for each twenty (20) feet of span, and one (1) inch additional for each foot of normal sag, but in

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no case shall the separation be less than that shown in the following table:

VOLTAGE BETWEEN CONDUCTORS		Separation
Exceeding	Not Exceeding	
	7,000	12 in.
7,000	14,000	20 in.
14,000	27,000	30 in.
27,000	35,000	36 in.
35,000	47,000	45 in.
47,000	70,000	60 in.
70,000		60 in. plus 0.6 in. per k.v. in excess of 70.

Where supported by insulators of the disc or suspension type, the minimum separation of conductors shall be increased by twenty-five (25) per cent., unless dead ended or otherwise prevented from swinging.

NOTE:—The separations specified in this paragraph do not apply to pole wiring.

613. Clearance between Conductors and Supports. Clearance between any power conductor, or live hardware, and any portion of the supporting structure (insulator pins not included), shall not be less than three (3) inches, plus twenty-five hundredths (0.25) of an inch for each kilo-volt in excess of seven (7). For conductors supported by suspension or disc type insulators and not dead ended at the pole structure, or otherwise prevented from swinging, clearance as above shall be figured on the assumption that the maximum deflection of the supporting insulators is forty-five (45) degrees from the vertical.

614. Gain Spacing. In no case shall the gain spacing between crossarms (buck arms excepted), be less than twenty-four (24) inches.

CONDUCTORS.

615. Material of Conductors. Conductors shall be of copper, copper-covered steel, aluminum, galvanized steel, or other corrosion resisting material, provided, however, that galvanized steel shall not be used in localities subject to excessive coal gases, or other conditions which would cause unusual corrosion.

616. Size of Conductors. The minimum allowable sizes for conductors of the crossing and adjoining spans are as follows:

Copper or Copper-covered Steel

Spans less than 150 feet.	No. 6 Am. Wire Gauge
Spans 150 feet and over	No. 4 " " "
Aluminum	No. 1 " " "
Galvanized Steel	5/16 in. diameter.

617. All aluminum and galvanized steel conductors shall be stranded.

NOTE:—The information available at present is not sufficient to show conclusively the relative reliability of stranded and solid copper conductors. Information is being collected on this subject and, until these data are available, no requirement as to the use of stranded or solid copper conductors is considered advisable.

618. Sag of Conductors. Conductors of the crossing and adjoining spans shall be strung with at least such sags as to withstand, with the designated factor of safety (Paragraph 661), the stresses due to the specified loading (Paragraph 658). See Appendix C for table of sags.

619. Splices in Conductors. The conductors in the crossing span shall be free from splices or taps. If a splice or tap is employed in any conductor in the next adjoining span, it shall be placed at a point nearer the crossing support than the distance from the crossing support of that conductor to the nearest wire crossed.

NOTE:—Where crossing is made under existing wires, the above requirement regarding splices may be waived with the consent of all parties in interest.

LIGHTNING PROTECTION WIRES.

620. Lightning Protection Wires. Lightning protection wires or cables, if used, shall conform to the requirements of specifications for conductors (Paragraphs 615, 616, 617, 618 and 619). When such wires are not connected to thoroughly grounded steel structures, they shall be permanently connected

to ground, at each crossing pole or tower, by a wire with a conductivity not less than No. 4 A. W. G. copper. The ground wire shall be connected directly to the lightning protection wire and to a well-made ground, and the course of this ground connection shall be as straight as possible.

INSULATORS.

621. Material of Insulators. Insulators on power lines shall be of porcelain, or other material which can be shown, to the satisfaction of the parties in interest, to be equally good in respect to mechanical and electrical requirements and durability.

622. Design of Insulators. Insulators shall be so designed that their dry flash-over is not more than seventy-five (75) per cent. of their puncture voltage, at a frequency of sixty (60) cycles.

623. Factor of Safety of Insulators. Insulators supporting the crossing and adjoining spans shall be capable of withstanding, without flash-over, at a frequency of sixty (60) cycles, the normal circuit voltage multiplied by the following factors:

VOLTAGE OF CIRCUIT		FACTOR	
Exceeding	Not Exceeding	Dry	Wet
	9,000	6.0	4.0
9,000	14,000	5.3	3.5
14,000	27,000	4.5	3.0
27,000	35,000	3.9	2.6
35,000	47,000	3.6	2.4
47,000	60,000	3.3	2.2
60,000		3.0	2.0

By the term "wet" is meant a condition equivalent to a precipitation of one-fifth ($1/5$) inch of rain per minute at an angle of forty-five (45) degrees to the axis of the insulator.

624. Tests. Each completed pin type insulator for line voltages over 15,000, and each completed suspension insulator disc, shall be subjected to a routine factory test at dry flash-over voltage, at a frequency of sixty (60) cycles for five (5) conse-

cutive minutes, or any other test which may be generally sanctioned by good modern practice.

625. Voltage Measurements. Test voltages shall be determined by methods conforming to the standards of the American Institute of Electrical Engineers.

626. Strain Insulators. Strain insulators, when used in guys, shall meet the following mechanical and electrical requirements:

- (a) Strain insulators shall be capable of withstanding the maximum mechanical stress to which the guy of which they are a part may be subjected, with the factors of safety given in Paragraph 661.
- (b) Strain insulators installed in guys shall be capable of withstanding, without puncture or flash-over, twice the maximum line voltage carried on either pole to which the guy is attached.

CONDUCTOR ATTACHMENTS.

627. Pins. Insulator pins shall be of steel, wrought-iron or malleable iron, and shall be galvanized. Cast-iron pin bases may be used. Pins of locust wood may be used, provided conditions are such that digestion or rapid deterioration of wood pins does not occur.

628. Strength of Pins, Insulators and Fastenings. Insulators, pins and conductor fastenings (including clamps, ties and dead-ends), carrying the crossing span, shall be designed

- (a) To withstand, with the designated factors of safety (Paragraph 661), the stresses produced by the conductor under the specified loading (Paragraph 658).
- (b) To withstand, with the designated factors of safety (Paragraph 661), the stress due to the pull in one direction of the conductor supported,—the pull being taken as the tension in the conductor due to the specified load (Paragraph 658).

A longitudinal movement of the conductor will be permitted, provided this movement will not reduce the designated clear-

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ances at the point of crossing (Paragraphs 608 and 609), by more than twenty-five (25) per cent. of the clearance required in Paragraph 609. In the calculation of stress, no allowance shall be made for deformation, deflection or displacement of any part of the structure.

Method of Attaching Conductors to Insulators. When the stress in the conductor, under the specified loading (Paragraph 658), does not exceed 2,000 pounds, the method of attaching conductors to double pin type insulators by tie wires, as shown in Appendix D, Figure 1, may be used to meet the requirements of this paragraph.

When the stress in the conductor, under the specified loading (Paragraph 658), exceeds 2,000 pounds, or when conditions are such that suspension or disc type insulators are desirable, a method of attaching conductors, satisfactory to all parties in interest, shall be used.

For suggested methods, see Appendix D.

629. Special Protection at Insulator. Where metal pins are used at either of the two crossing supports, or where wood pins are used and the crossarms are grounded (wood pins and non-grounded construction being generally used in other parts of the line), the insulators used on such metal or grounded supports shall have an electrical factor of safety fifty (50) per cent. greater than at other parts of the line, but in no case less than as specified in Paragraph 623.

As an alternative, the conductors, at their points of attachment to the insulators at the crossing span, may be protected by arcing shields as shown in Appendix D.

NOTE:—The purpose of the foregoing requirements, described in Paragraphs 628 and 629, is to guard against the failure of the construction due to any of the following accidental conditions:

I. Mechanical Failures.

- (a) Failure due to the stresses produced by the conductors under the specified loading (Paragraph 658).

- (b) Failure due to unbalanced stresses in conductors, resulting from conductor, insulator, pin, or conductor fastening failing at the adjoining pole or tower.
- (c) Failure due to a broken or damaged insulator.

II. Electrical Failures.

- (a) Burning, by arcs or leakage current due to the failure of an insulator, pin, or conductor fastening, of any wooden part of the supporting structure which, if burned, would render the conductor liable to fall.
- (b) Burning or weakening of the conductor, at the insulator, due to arcs or leakage current.

Other methods of guarding against these accidental conditions may be used, if agreed upon by the parties in interest, as being equally effective as the methods herein described.

CROSSARMS.

630. Crossarms. The crossarms carrying the crossing span shall be of at least the following dimensions:

- (a) Wood crossarm— $3\frac{1}{2}$ in. x $4\frac{1}{2}$ in.
- (b) Steel “ —3 in. x 3 in. x $5/16$ in.

631. Crossarms carrying the crossing span shall be attached to the poles with through bolts and shall be equipped with suitable galvanized iron braces. Double crossarms shall be fitted with spacing bolts, equipped with spacing nuts and washers, pipe spacers, or similar construction, or with spacing blocks or plates.

632. Strength of Crossarms. The crossarms carrying the crossing span, including their fastenings to the poles or towers, shall be designed:

- (a) To withstand, with the designated factors of safety (Paragraph 661), the stresses produced by the conductors under the specified loading (Paragraph 658).
- (b) To withstand, at all times without failure, the unbalanced stress due to the combined pull in one direction of all the conductors supported,—the pull of each conductor being taken as the tension in the conductor due to the specified load (Paragraph 658).

In the calculation of stress, no allowance shall be made for the deformation, deflection or displacement of any part of the structure.

For method of figuring strength of double crossarms, see Appendix E.

SUPPORTING STRUCTURES.

633. Wooden Poles. Wooden poles supporting the crossing span shall be of chestnut or other selected timber, reasonably straight, peeled, free from defects which decrease their strength or durability, and not less than twenty-two (22) inches in circumference at the top.

634. Steel Towers. Steel for structures supporting the crossing span shall conform to the "Specifications for Structural Steel for Buildings," as adopted by the American Society for Testing Materials.

635. Design and workmanship shall be in accordance with good modern practice.

636. The form of the frame shall be such that stresses may be computed with reasonable accuracy, or the strength of the structure shall be determined by actual test.

637. Construction shall be such that all parts are accessible for inspection, cleaning and painting, and shall not permit of pockets in which water or dirt might collect.

638. The unsupported length of a tower leg shall not exceed 140 times its least radius of gyration.

The unsupported length of a secondary compression member, having figured stress, shall not exceed 180 times its least radius of gyration.

The unsupported length of a compression member, placed to reduce the unsupported length of a leg or secondary member (therefore having no figured stress), shall not exceed 200 times its least radius of gyration.

639. The minimum thickness of metal in galvanized structures shall be one-quarter ($\frac{1}{4}$) inch for main members and three-sixteenths ($\frac{3}{16}$) inch for all other members. The minimum thickness of metal in painted structures shall be one-quarter ($\frac{1}{4}$) inch.

640. Strength of Supporting Structures. The poles or towers supporting the crossing span shall be designed:

- (a) To withstand, with the designated factor of safety (Paragraph 661), the combined stresses produced by their own weight, the specified wind pressure on the poles or towers (Paragraph 659), and the specified conductor loading (Paragraph 658), on all conductors supported in both the crossing span and the next adjoining span.
- (b) To withstand, at all times without failure, the unbalanced stress due to the combined pull in the direction of the crossing of all the conductors supported,—the pull of each conductor being taken as the tension in the conductor due to the specified load (Paragraph 658).

NOTE:—In designing steel towers, to withstand this unbalanced stress, the maximum allowable unit fibre stress shall be:
For tension members: 24,000 lbs. per square inch.

For compression members: $24,000 - \frac{60L}{R}$ lbs. per square inch

In the case of wooden or steel poles, when head guys are used to meet this requirement, this unbalanced stress may be assumed to be distributed equally over one or more poles adjoining the crossing, provided all the construction between the crossing span and any such poles is in conformity with these specifications.

In the calculation of stress, no allowance shall be made for the deformation, deflection or displacement of any part of the structure.

641. In the case of wooden pole construction, where the requirements of Paragraph 640 (a) cannot be met except by the use of side guys or special structures, and it is physically impracticable to employ side guys at the crossing poles, the requirements of Paragraph 640 (a) may be met by side-guying the line as near as practicable to the crossing but at a distance not exceeding 500 feet from the point of crossing, provided:

- (a) The side-guyed poles shall be designed to withstand the stress due to wind and ice loading transversely to the line, on the assumption that the whole transverse strain of the line, between the poles so side-guyed, is carried by them.

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- (b) The line between such guyed poles and the crossing shall be substantially in a straight line with the crossing poles.
- (c) The average length of span between the guyed poles and the crossing shall not be in excess of 150 feet.

When these conditions are met, and the crossing line between the guyed poles is otherwise constructed in accordance with these specifications, then, for the intervening poles, considered individually, without reinforcement from adjoining poles, the requirements of Paragraph 640 (a) may be modified to the extent of reducing the specified factor of safety, depending upon the number of wires carried, as per the following table:

Number of Wires	Factor of Safety
4	4.0
6	3.5
12	2.0
18	1.4
24 or more	1.0

642. Pole setting. Poles shall be set in the ground to depths not less than those shown in the following tabulation:

Total Length of Pole (Feet)	Depth in Earth (Feet)
25	5.5
30	6.0
35	6.0
40	6.5
45	7.0
50	7.0
55	7.5
60	7.5
65	8.0
70	8.0
75	8.5
80	8.5

When poles are set in rock, the depth of the setting may be decreased, depending upon its character, but this depth shall never be less than four (4) feet.

643. Where located in soft or swampy ground, the setting of poles shall be suitably reinforced. This may be done by setting in barrels of broken stone or gravel, or in stone or timber footings, or by any other equally effective method.

644. Where located in the sides of banks, or where subject to washouts, foundations or pole settings shall be given additional depth, or be protected by cribbing or riprap.

645. Backfillings for foundations or pole settings shall be carefully tamped, or otherwise thoroughly compacted, while being placed.

646. **Foundations for Steel Towers.** Foundations for towers supporting the crossing span shall be adequate to withstand, with the designated factor of safety (Paragraph 661), the maximum stress to which they will be subjected when wires and structures are loaded in accordance with Paragraphs 640, 658 and 659.

647. In designing foundations for towers, the weight of concrete shall be considered as 140 pounds per cubic foot. The weight of "earth" (calculated at thirty (30) degrees from the vertical), shall be considered, in good ground, as 100 pounds per cubic foot. In swampy ground, special measures shall be taken to prevent uplift or depression.

648. The top of a concrete foundation, or casing, shall extend at least six (6) inches above the surface of the ground, except when pavements or sidewalks make this impracticable, and shall have sufficient slope to prevent collection of water.

649. **Identification.** For the purpose of identification, poles or structures supporting the crossing span shall be clearly marked with the name, initials, or trade-mark of the owner of the structure.

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GUYS.

650. Use of Guys. Guys may be used in meeting the specified strength requirements for supports (Paragraph 640). The number and arrangement of guys shall be determined by the conditions existing at the crossing. Braces may be used instead of guys. Where head guys are installed on poles supporting the crossing span, they shall be so installed as not to increase appreciably the stress in the conductors of the crossing span.

651. Where poles, not self-supporting, are guyed, they become rigid structures acting only as struts, and the horizontal component of the load will be considered as taken entirely by the guys. Where steel structures, not self-supporting, are guyed, they act as struts and also as beams. In figuring the strength of such structures and their guys, the structures, considered alone, may be figured as carrying such portion of the horizontal component of the load, together with the vertical component of the load acting on the structure as a strut, as will not stress any part of the structure beyond the designated factor of safety (Paragraph 661). The remaining portion of the horizontal component of the load shall be figured as carried by the guys with the designated factor of safety (Paragraph 661).

652. Material. Guys shall be galvanized or copper covered stranded steel cable, or rolled rods, and must have a minimum nominal diameter of five-sixteenths ($5/16$) inch.

653. Anchorage. Guys to ground shall be connected to a well-anchored rod of such length that the eye of the rod shall be above the surface of the ground. Rods with a diameter of less than one (1) inch shall be galvanized.

654. Guy anchors shall, when practicable, be placed at a horizontal distance from the poles they reinforce, measured at the ground line, of not less than one-third ($1/3$) of the height of the point of attachment of the guy to the pole.

655. **Guy Stubs.** Guy stubs, or poles used as guy stubs, with their foundations, anchorages and reinforcements, shall be adequate to withstand, with the designated factor of safety (Paragraph 661), the maximum stress to which they will be subjected when wires and structures are loaded in accordance with Paragraphs 640, 658 and 659.

656. **Strain Insulators.** A strain insulator, when used, shall conform to requirements of Paragraph 626, and in general shall be placed not less than six (6) feet below the lowest conductor, not less than eight (8) feet above the ground, and, where practicable, not less than six (6) feet, in a horizontal direction, from the pole. When it is impracticable to comply with the provisions of Paragraph 611, strain insulators shall be so placed as to protect pedestrians and men working on either line. Guys not equipped with strain insulators shall be permanently and effectually grounded.

PROTECTIVE COATINGS.

657. **Protective Coatings on Steel.** All structural steel shall be thoroughly cleaned at the shop, and shall be galvanized or painted, as follows:

- (a) *Painting.* Painting shall consist of one (1) complete shop coat, one (1) field coat on all contact surfaces before assembling, and one (1) complete field coat after assembling. Before painting in the field, the surface of the metal shall again be thoroughly cleaned of all dirt, grease, etc., and worn or defaced spots shall be touched up. No painting shall be done in freezing or rainy weather.
- (b) *Galvanizing.* Galvanized material shall meet the requirements specified by the National Electric Light Association, or other standard generally sanctioned by good modern practice.
Sherardizing of small parts is permitted.
All holes in galvanized material shall be made before galvanizing.

LOADS.

658. Loads. The conductors shall be considered as loaded uniformly throughout their length with a load equivalent to the resultant of the dead load, the weight of a layer of ice one-half ($\frac{1}{2}$) inch in thickness, and a wind pressure of eight (8) pounds per square foot of ice-covered diameter, at a temperature of zero (0) degrees Fahrenheit. The weight of the ice shall be assumed as fifty-seven (57) pounds per cubic foot (0.033 pounds per cubic inch).

659. The supporting structures shall be considered as subjected to a wind pressure of:

- (a) Eight (8) pounds per square foot on the projected area of cylindrical surfaces, such as wood or tubular steel poles.
- (b) Thirteen (13) pounds per square foot on the projected area of flat surfaces, such as cross-arms, etc.
- (c) Thirteen (13) pounds per square foot on twice the projected area of one of two parallel faces of latticed or trussed structures.

The areas above enumerated shall be considered as increased by one-half ($\frac{1}{2}$) inch of ice on all the exposed surfaces.

660. Temperatures. Computation of stresses due to the temperature load shall be based upon an assumed temperature of minus twenty (-20) degrees Fahrenheit.

GENERAL REQUIREMENTS.

661. Mechanical Factors of Safety. In design and construction the ultimate unit strength divided by the allowable working unit stress shall be not less than the values shown in the following tabulation:

Wires, cables and conductor attachments	2
Pins	2
Pole line hardware	2
Line insulators (mechanical)	3
Guy insulators—non-interlocking	3
“ “ —interlocking	2
Guys	3
Wooden poles	4
Wooden crossarms	4
Structural steel poles, towers and crossarms	3
Reinforced concrete poles and crossarms	4
Foundations and anchorages	2

Allowable working unit stresses, as given in Appendix F, are derived by dividing generally approved ultimate unit strengths by the factors of safety shown above.

662. Other Construction Requirements. Construction requirements for all crossings, where not covered by these specifications, shall be according to the best modern practice.

ALTERNATIVE TYPES OF CONSTRUCTION.

663. The following describes methods of construction which offer alternatives to some of the foregoing requirements. Unless specifically excepted, all the foregoing requirements will apply to these types of construction.

664. Short Span Method. This method consists in making a short span at such a height that the radial distance, from the lowest insulators of the crossing span to the nearest wires of the span crossed, is greater than the length of the crossing span.

Conductors not meeting the requirements of Paragraphs 615 to 619, inclusive, may be used, provided a grounded guard arm is placed on each of the crossing poles or towers in such a manner as to prevent the upper wires in the next adjoining spans from whipping back into the wires crossed in case of failure of the upper wires. The requirements which may be omitted when this construction is used are Paragraphs 606, 615 to 619, inclusive, and 621 to 625, inclusive.

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If conductors which meet the requirements of Paragraphs 615 to 619, inclusive, are used, and the next adjoining spans to the crossing are not less in length than twice the height above ground of the highest wire of the crossing spans, the grounded guard arms may be omitted.

To avoid the necessity for poles or towers of excessive height, as supports for the crossing span:

- (a) The line crossed shall be built as low as possible.
- (b) On Class C lines so crossed, the horizontal distance between conductors may be reduced to permit the crossing poles or towers to be placed nearer together.

See Appendix G.

665. Use of Cable. The power wires may be carried in aerial, armored, or metal sheath cable, in which case the requirements of the following paragraphs may be omitted:

609, 612 to 614, inclusive

621 to 625, inclusive

627, 628 and 629.

The vertical clearance from the cable to any conductor of the span crossed shall be not less than forty (40) inches.

The provisions of Paragraphs 615, 616, 617, 618 and 619 shall apply to the supporting messenger wire, but not to the cable or cable conductors.

The provisions of Paragraphs 630, 631 and 632 shall apply where cable is suspended from crossarms and not otherwise.

The messenger and armor or metal sheath of the cable shall be permanently and effectually grounded. The cable shall extend at least one span on each side of the crossing. The cable shall be capable of withstanding at least twice the normal line voltage between any two conductors, or between any conductor and the sheath or armor.

666. For cause shown, in special cases, the Commission may afford relief from the operation of these Regulations to any particular public utility when public convenience and safety will not be injuriously affected thereby, and the welfare of such public utility will be subserved by modifications of any of the foregoing Regulations and Specifications.

SECTION VII.

SPECIFICATIONS FOR THE CONSTRUCTION OF OVER-
HEAD LINES CROSSING UNDER
RAILROAD BRIDGES.

701. Scope. These specifications apply to crossings under railroad bridges of all classes of overhead lines.

702. Use of Cable. Conductors may be installed beneath bridges in a metal conduit, or armored or metal sheath cable. The conduit or messenger (if any), and the armor or metal sheath of the cable shall be permanently and effectually grounded. The insulation of such conductors shall be capable of withstanding at least twice the normal line voltage between any two conductors or between any conductor and the sheath or armor. If such conductors are attached to the bridge structure, they shall be supported in accordance with Paragraph 706.

703. Clearance from Abutments. The clearance between any conductor and the face of the abutment shall be not less than three (3) feet for steel bridges, or other bridges with accessible wing walls, or one (1) foot for concrete slab, and brick, stone or concrete arch bridges with inaccessible wing walls or without wing walls, but in no case shall the clearance between any conductor and the face of the abutment be less than that required in Paragraph 704.

704. Clearance from Bridge Structures. The clearance between any conductor, attached to the bridge in open construction, and any portion of the bridge structure, shall be not less than the following:

NOMINAL OPERATING VOLTAGE		CLEARANCE	
Exceeding	Not Exceeding	Minimum	Preferable
	2,500	6 in.	1 ft.
2,500	5,000	1 ft.	2 ft.
5,000	7,000	3 ft.	
7,000	14,000	5 ft.	
14,000	27,000	7.5 ft.	
27,000	35,000	9 ft.	
35,000		12 ft.	

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705. Separation of Conductors. The separation between conductors attached to bridges in open construction shall be not less than the following:

Distance Between Supports	Minimum Distance Between Conductors
Up to 20 ft.	6 in.
20 ft. " 50 ft.	9 in.

706. Distance between Supports. Conductors attached to the under side of bridges shall have at least two points of support; the distance between supports shall not exceed fifty (50) feet.

707. Insulating Material. Insulators on Class B, Class C and Class D-1 lines shall be of porcelain, glass or other reliable insulating material. Insulators on Class A and Class D-2 lines shall be of porcelain or other material which can be shown to the satisfaction of the parties in interest, to be equally good in respect to mechanical and electrical requirements and durability.

708. Factor of Safety of Insulators. Insulators supporting the crossing and adjoining spans shall be capable of withstanding without flash-over, at a frequency of sixty (60) cycles, the normal circuit voltage multiplied by the following factors:

VOLTAGE OF CIRCUIT		FACTOR	
Exceeding	Not Exceeding	Dry	Wet
	9,000	6.0	4.0
9,000	14,000	5.3	3.5
14,000	27,000	4.5	3.0
27,000	35,000	3.9	2.6
35,000	47,000	3.6	2.4
47,000	60,000	3.3	2.2
60,000		3.0	2.0

By the term "wet" is meant a condition equivalent to a precipitation of one fifth ($1/5$) inch of rain per minute at an angle of forty-five (45) degrees to the axis of the insulator.

709. Tests. Each completed pin insulator for line voltages over 15,000, and each completed suspension insulator disc, shall be subjected to a routine factory test at dry flash-over voltage,

at a frequency of sixty (60) cycles for five (5) consecutive minutes, or any other test which may be generally sanctioned by good modern practice.

710. Voltage Measurements. Test voltages shall be determined by methods conforming to the standards of the American Institute of Electrical Engineers.

711. Protection from Arcing at Insulator. When power lines are attached to steel bridges (wood pins and non-grounded construction being generally used in other parts of the line), the insulators used at the bridge attachments shall have an electrical factor of safety fifty (50) per cent. greater than at other parts of the line, but in no case less than as specified in Paragraph 708.

712. Conductor Attachment. Conductors attached to bridges in open construction shall be attached to pin type insulators by tie wires or clamps. Suggested methods of attachment are shown in Appendix D.

713. Pins. Insulator pins shall be of steel, wrought-iron or malleable iron, and shall be galvanized. Cast-iron pin bases may be used. Pins of locust wood may be used, provided conditions are such that digestion or rapid deterioration of wood pins does not occur.

714. Pin Supports. Wooden pin supports shall not be less than three (3) inches by four and one-fourth ($4\frac{1}{4}$) inches in section. Suggested method of supporting under steel bridges is shown in Appendix I, Figure 1. Where open construction is used, pin supports shall be so arranged that insulators shall be used in the position for which they are designed.

715. Identification. The pin supports attached to the bridge shall be plainly marked with the name, initials or trade-mark of the owner of the structure, and in addition, for voltages in excess of 500, by a sign reading "**Danger—Do Not Touch.**"

716. Trolley Contact Wires. Trolley contact wires attached to bridges shall be provided with a substantial, inverted trough of non-conducting material, or other means to keep the trolley pole from contact with the bridge structure. This protection shall be not less in length than the overall width of the bridge, measured along the line of the protection. Suggested method is shown in Appendix I, Figure 2.

717. Crossing Without Attachment. When clearances between all conductors in open construction in any direction from the bridge structure, as given in the following tabulation, are obtained without attachment to the bridge structure, the provisions of Paragraphs 704 to 716, inclusive, do not apply, and the line may be built according to Section II of these specifications.

NOMINAL Exceeding	OPERATING VOLTAGE Not Exceeding	Clearance
	7,000	3 ft.
7,000	14,000	5 ft.
14,000	27,000	7.5 ft.
27,000	35,000	9 ft.
35,000		12 ft.

718. For cause shown, in special cases, the Commission may afford relief from the operation of these Regulations to any particular public utility when public convenience and safety will not be injuriously affected thereby, and the welfare of such public utility will be subserved by modifications of any of the foregoing Regulations and Specifications.

SECTION VIII.**SPECIFICATIONS FOR THE CONSTRUCTION OF OVER-
HEAD LINES CROSSING RAILROADS BY
MEANS OF UNDERGROUND
CONSTRUCTION.**

801. Scope. These specifications apply to the crossings of all classes of wire lines crossing railroad tracks underground.

802. Conduit. Wires or cables shall be carried in some suitable form of vitrified earthenware, treated fibre, creosoted wood duct or iron pipe conduit, of a size sufficient to permit the wires or cables to be readily drawn in, and shall terminate in manholes, pull boxes or terminals. Wherever practicable, such manholes, pull boxes or terminals shall not be placed on the railroad right of way.

803. Depth. The top of the conduit shall be located at a depth of not less than four (4) feet below the base of the rail, nor less than two (2) feet, six (6) inches below the surface of the ground at the lowest point of crossing of the railroad right of way. Wherever practicable, conduit shall be laid with a uniform slope of not less than three (3) inches per 100 feet, to drain away from the crossing.

804. Terminals. Where manholes, pull boxes or terminals project above the elevation of the top of the rail, unless physical conditions or municipal requirements prevent, they shall have horizontal clearance from the nearest track rail of not less than twelve (12) feet, except that at sidings a clearance of seven (7) feet may be allowed. At loading sidings, sufficient space shall be left for a drive-way.

805. Protection. Conduit, excepting iron pipe, located at a depth of less than six (6) feet below the top of the rail, shall

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be protected on top by a slab of concrete not less than six (6) inches in thickness, or by creosoted wooden planks not less than two (2) inches in total thickness; this protection shall extend not less than three (3) inches on each side beyond the outer lines of the conduit.

NOTE:—In using creosoted planks to meet this requirement, more than one plank may be used.

806. For cause shown, in special cases, the Commission may afford relief from the operation of these Regulations to any particular public utility when public convenience and safety will not be injuriously affected thereby, and the welfare of such public utility will be subserved by modifications of any of the foregoing Regulations and Specifications.

**SECTION IX.
APPENDICES.
APPENDIX A.**

Section II, Paragraph 210.

Section V, Paragraph 540.

Minimum Sags for Hard and Soft Drawn Copper Wire.

NOTE:—These tables are to be used in constructing only such crossings as come within the scope of Sections II and V. For sag tables to be used in connection with Sections III and VI, see Appendix C.

**No. 10 A. W. G. HARD DRAWN BARE COPPER WIRE.
Temperature.**

Length of Span In Feet	0° F.	20° F.	40° F.	60° F.	80° F.	100° F.
80	1½	2	2½	3	3½	5
90	2	2½	3	3½	4½	6
100	2½	3	3½	4½	5½	7
110	3	3½	4½	5½	6½	8½
120	5	6	7	9	11½	14½
130	8½	10½	13	16½	19½	23
140	15½	19	22½	25½	29	32
150	25½	29	32½	35½	38	41

**No. 6 A. W. G. SOFT DRAWN COVERED COPPER WIRE.
Temperature.**

Length of Span In Feet	0° F.	20° F.	40° F.	60° F.	80° F.	100° F.
60	3	4	5	6	8	9
70	5	6	7	9	11	12
80	6	7	10	12	14	15
90	8½	10	13	15	17	19
100	12	14	16	19	21	23
110	16	18	21	23	25	27
120	19½	22	25	27	30	32
130	25½	27	30	32	35	37
140	30½	33½	36	38½	41	43
150	39½	42	44½	46½	49	51

APPENDIX B.

SPECIFICATIONS FOR WOOD POLES

As Contained in

"HANDBOOK ON OVERHEAD LINE CONSTRUCTION"

of the

NATIONAL ELECTRIC LIGHT ASSOCIATION.

SPECIFICATIONS FOR CHESTNUT POLES.

To determine the character of poles to be used, pole lines may be divided into the three following classes:

Class "A": For heavy transmission lines or heavy distribution lines.

Class "B": For light transmission lines or ordinary distribution lines.

Class "C": For very light distribution lines or light secondary lines.

The purchasing company is to have the right to make such inspections of the poles as it may desire. The inspector of the purchasing company shall have the power to reject any pole which is defective in any respect. Inspection, however, shall not relieve the manufacturer from furnishing perfect poles.

Any imperfect poles which may be discovered before their final acceptance shall be replaced immediately upon the requirement of the purchasing company, notwithstanding that the defects may have been overlooked by the inspector. If the requirements of these specifications are not fulfilled when the poles are offered for final acceptance, not only shall the purchasing company have the right to reject the poles, but the expense of inspection of such defective poles shall be borne by the manufacturer.

*National Electric Light Association Specification.

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All poles shall be subject to inspection by the purchasing company, either in the woods where the trees are felled, or at any point of shipment or destination. Any pole failing to meet all the requirements of these specifications may be rejected.

All poles shall be of the best quality live white chestnut, squared at both ends, reasonably straight, well proportioned from butt to top, peeled and with knots trimmed close.

The dimensions of poles shall be according to the following table:

DIMENSIONS OF POLES IN INCHES.

LENGTH OF POLES (FEET)	CLASS "A"		CLASS "B"		CLASS "C"	
	Top	6 ft. from Butt	Top	6 ft. from Butt	Top	6 ft. from Butt
25	24	37	22	33	20	30
30	24	40	22	36	20	33
35	24	43	22	40	20	36
40	24	45	22	43	20	40
45	24	48	22	47	20	43
50	24	51	22	50	20	46
55	22	54	22	53	20	49
60	22	57	22	56		
65	22	60	22	59		
70	22	63	22	62		
75	22	66	22	65		
80	22	70	22	69		
85	22	73	22	72		
90	22	76	22	75		

the "Top" measurements being the circumference at the top of the pole, and the "Butt" measurement being the circumference six (6) feet from the butt.

SPECIFICATIONS FOR EASTERN WHITE CEDAR POLES.*

The material desired under these specifications consists of poles of the best quality of either seasoned or live green cedar of the dimensions hereinafter specified. Seasoned poles shall have preference over green poles provided they have not been held for seasoning long enough to have developed any of the

*National Electric Light Association Specification.

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timber defects hereinafter referred to. All poles shall be reasonably straight, well proportioned from butt to top, shall have both ends squared, the bark peeled and all knots and limbs closely trimmed.

Dimensions.

The dimensions of the poles shall be in accordance with the following table, the "top" measurement being the circumference at the top of the pole, and the "butt" measurement the circumference six (6) feet from the butt.

MINIMUM DIMENSIONS OF POLES IN INCHES
(CIRCUMFERENCE).

LENGTH OF POLES (FEET)	CLASS "A"		CLASS "B"		CLASS "C"	
	Top	6 ft. from Butt	Top	6 ft. from Butt	Top	6 ft. from Butt
25	24	36	22	32	18 $\frac{3}{4}$	30
30	24	40	22	36	18 $\frac{3}{4}$	33
35	24	43	22	38	18 $\frac{3}{4}$	36
40	24	47	22	43	18 $\frac{3}{4}$	40
45	24	50	22	47	18 $\frac{3}{4}$	43
50	24	53	22	50	18 $\frac{3}{4}$	46
55	24	56	22	53	18 $\frac{3}{4}$	49
60	24	59	22	56	18 $\frac{3}{4}$	52

When the dimension at the butt is not given the poles shall be reasonably well proportioned throughout their entire length.

The dimension requirement at the six (6) foot mark shall be rigidly followed in all cases. Class "A," "B" and "C" poles may have top circumference not more than one-half ($\frac{1}{2}$) inch less than those shown in the preceding table. No pole shall be over six (6) inches longer or three (3) inches shorter than the length for which it is accepted; if any pole be more than six (6) inches longer than is required it shall be cut back.

Quality of Timber.

Dead Poles. The wood of a dead pole is grayish in color. The presence of a black line on the edge of the sapwood (as seen on the butt) also shows that a pole is dead. No dead poles, and no poles having dead streaks covering more than one-

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quarter ($\frac{1}{4}$) of their surface shall be accepted under these specifications. Poles having dead streaks covering less than one-quarter ($\frac{1}{4}$) of their surface shall have a circumference greater than otherwise required. The increase in the circumference shall be sufficient to afford a cross-sectional area of sound wood equivalent to that of sound poles of the same class.

Fire Killed or River Poles. No dark red or copper colored poles, which when scraped do not show good live timber shall be accepted under these specifications.

Twisted, Checked or Cracked Poles. No poles having more than one complete twist for every twenty (20) feet in length, no cracked poles containing large season checks shall be accepted under these specifications.

"Cat Faces." No poles having "Cat Faces," unless they are small, and perfectly sound and the poles have an increased diameter at the "cat face," and no poles having "cat faces" near the six (6) foot mark, or within ten (10) feet of their tops, shall be accepted under these specifications.

Shaved Poles. No shaved poles shall be accepted under these specifications.

Miscellaneous Defects. No poles containing sap rot, evidence of internal rot as disclosed by a careful examination of all black knots, hollow knots, woodpecker holes, or plugged holes; and no poles showing evidences of having been eaten by ants, worms or grubs shall be accepted under these specifications, except that poles containing worm or grub marks below the six (6) foot mark will be accepted.

Crooked Poles. No poles having a short crook or bend, a crook or bend in two planes or a reverse curve shall be accepted under these specifications. The amount of sweep, measured between the six (6) foot mark and the top of the pole, that may

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be present in poles acceptable under these specifications, as shown in the following table:

- 35 foot poles shall not have a sweep over $10\frac{1}{2}$ inches.
- 40 foot poles shall not have a sweep over 12 inches.
- 45 foot poles shall not have a sweep over 9 inches.
- 50 foot poles shall not have a sweep over 10 inches.
- 55 foot poles shall not have a sweep over 11 inches.
- 60 foot poles shall not have a sweep over 12 inches.

Defective Tops. Poles having tops of the required dimensions must have sound tops. Poles having top one (1) inch or more above the requirements in circumference may have one (1) pipe rot not more than one-half ($\frac{1}{2}$) inch in diameter. Poles with double tops or double hearts shall be free from rot where the two parts or hearts join.

Defective Butts. No poles containing ring rot (rot in the form of a complete or partial ring) shall be accepted under these specifications.

Poles having hollow hearts may be accepted under the conditions shown in the following table:

AVERAGE DIAMETER OF ROT	ADD TO BUTT REQUIREMENTS		
	of 24 and 30 Foot Poles	of 35, 40, 45 Foot Poles	of 50, 55, 60, 65 Foot Poles
2 inches	Nothing	Nothing	Nothing
3 inches	1 inch	Nothing	Nothing
4 inches	2 inches	Nothing	Nothing
5 inches	3 inches	1 inch	Nothing
6 inches	4 inches	2 inches	1 inch
7 inches	Reject	4 inches	2 inches
8 inches	Reject	6 inches	3 inches
9 inches	Reject	Reject	4 inches
10 inches	Reject	Reject	5 inches
11 inches	Reject	Reject	7 inches
12 inches	Reject	Reject	9 inches
13 inches	Reject	Reject	Reject

Scattered rot, unless it is near the outside of the pole, may be estimated as being the same as heart rot of equal area.

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"Wind Shakes." Poles with cup shakes (checks in the form of rings) which also have heart or star checks may be considered as equal to poles having hollow hearts of the average diameter of the cup shakes.

Inspection. All poles shall be subject to inspection by the purchaser's representative, either in the woods where the trees are felled, or at any point of shipment, or destination. Each pole thus inspected shall be marked according to its length and class with a marking hammer, by the purchaser's representative. All poles failing to meet these specifications shall be rejected.

**SPECIFICATIONS FOR WESTERN WHITE CEDAR, RED CEDAR,
WESTERN CEDAR, IDAHO CEDAR.***

General.

The material desired under these specifications consists of poles and guy stubs of the best quality of either seasoned or live green cedar of the dimensions hereinafter specified. The poles covered by these specifications are of Western White Cedar, otherwise known as red cedar, western cedar, or Idaho cedar. Seasoned poles shall have preference over green poles provided they have not been held for seasoning long enough to have developed any of the timber defects hereinafter referred to. All poles shall be reasonably straight, well proportioned from butt to top, shall have both ends squared, sound tops, the bark peeled, and all knots and limbs closely trimmed.

Dimensions.

The dimensions of the poles shall be in accordance with the following table, the "top" measurement being the circumference at the top of the pole and the "butt" measurement, the circumference six (6) feet from the butt. The dimensions given are the minimum allowable circumferences at the point specified for measurement and are not intended to preclude the acceptance of poles of larger dimensions.

*American Telephone & Telegraph Company Specification.

APPENDIX B—Page 7.

When the dimension at the butt is not given, the poles shall be reasonably well proportioned throughout their entire length. No pole shall be over six (6) inches longer or three (3) inches shorter than the length for which it is accepted. If any pole is more than six (6) inches longer than is required it shall be cut back.

MINIMUM DIMENSIONS OF POLES IN INCHES.

LENGTH OF POLES (FEET)	CLASS "A" (Minimum Top Circumference 28) 6 Feet from Butt	CLASS "B" (Minimum Top Circumference 25) 6 Feet from Butt	CLASS "C" (Minimum Top Circumference 22) 6 Feet from Butt
	Circumference	Circumference	Circumference
20	30	28	26
22	32	30	27
25	34	31	28
30	37	34	30
35	40	36	32
40	43	38	34
45	45	40	36
50	47	42	38
55	49	44	40
60	52	46	41
65	54	48	43

QUALITY OF TIMBER.

Dead Poles. No dead poles and no poles having dead streaks covering more than one-quarter of their surface shall be accepted under these specifications. Poles having dead streaks covering less than one-quarter of their surface shall have a circumference greater than otherwise required. The increase in the circumference shall be sufficient to afford a cross sectional area of sound wood equivalent to that of sound poles of the same class.

Twisted, Checked or Cracked Poles. No poles having more than one (1) complete twist for every twenty (20) feet in length, no cracked poles, and no poles containing large season checks, shall be accepted under these specifications.

Crooked Poles. No poles having a short crook or bend, a crook or bend in two planes, or a reverse crook or bend, shall

APPENDIX B—Page 8.

be accepted under these specifications. The amount of sweep measured between the six (6) foot mark and the top of the pole, shall not exceed one (1) inch to every six (6) feet in length.

"Cat Faces." No poles having "cat faces," unless they are small and perfectly sound, and the poles have an increased diameter at the "cat face" and no poles having "cat faces" near the six (6) foot mark, or within ten (10) feet of their tops shall be accepted under these specifications.

Shaved Poles. No shaved poles shall be accepted under these specifications.

Wind Shakes. No poles shall have cup shakes (checks in the form of rings) containing heart or star shakes which enclose more than ten (10) per cent. of the area of the butt.

Butt Rot. No poles shall have butt rot covering in excess of ten (10) per cent. of the total area of the butt. The butt rot, if present, must be located close to the center in order that the pole may be accepted.

Knots. Large knots, if sound and trimmed close, shall not be considered a defect. No poles shall contain hollow or rotten knots.

Miscellaneous Defects. No poles containing sap rot, woodpecker holes or plugged holes, and no poles showing evidences of having been eaten by worms, ants, or grubs shall be accepted under these specifications.

SPECIFICATIONS FOR SAWED RED WOOD POLES.*

General. The material desired under these specifications consists of poles of redwood (*Sequois Sempervirens*) sawed to shape as hereinafter set forth.

*American Telephone & Telegraph Company Specification.

APPENDIX B—Page 9.

Quality of Timber and Workmanship. All poles shall be of sound Number One Common Redwood; they should be reasonably straight and well sawn.

Dimensions. The dimensions of the poles shall be in accordance with the following table:

LENGTH IN FEET	"A"		"B"	
	Top	Butt	Top	Butt
24	6" x 6"	6" x 6"	4" x 6"	4" x 6"
25	7" x 7"	10" x 10"	6" x 6"	9" x 9"
30	7" x 7"	11" x 11"	6" x 6"	10" x 10"
35	7" x 7"	12" x 12"	6" x 6"	11" x 11"
40	7" x 7"	13" x 13"	6" x 6"	12" x 12"
45	7" x 7"	14" x 14"	6" x 6"	13" x 13"
50	7" x 7"	15½" x 15½"	6" x 6"	14" x 14"

The sectional dimensions of the sawn poles shall not be more than one-quarter ($\frac{1}{4}$) of an inch under, or three-quarters ($\frac{3}{4}$) of an inch over, the dimensions specified in the above table. No pole shall be more than three (3) inches longer or shorter than the lengths required in the above table.

Sapwood. No pole shall have sapwood covering more than four (4) per cent. of the area of all the surfaces. No pole shall have sapwood for a distance of more than eight (8) feet from the top. No sapwood shall be deeper than one (1) inch at any point.

Plugged Holes. No poles shall have plugged holes.

Cracked Poles. No poles shall contain cracks transverse to the length of the pole.

Checked Poles. No pole shall contain large season checks.

Wind Shakes. No pole shall contain wind shakes including in excess of ten (10) per cent. of the area of the butt.

APPENDIX B—Page 10.

Knots. No poles shall contain loose, hollow, or rotten knots, black or red knots shall be carefully examined for internal rot.

In four (4) inch by six (6) inch poles sound knots with a diameter smaller than one (1) inch may be present in any number. No four (4) inch by six (6) inch pole shall be accepted which contains more than one sound knot in each five (5) superficial feet having a diameter of one (1) inch or more, or which contains any knots with a diameter greater than one and one-half ($1\frac{1}{2}$) inch.

In all other sizes of poles covered by these specifications sound knots with a diameter smaller than one and one-half ($1\frac{1}{2}$) inches may be present in any number. No pole shall be accepted which contains more than one sound knot in each five (5) superficial feet having a diameter of one and one-half ($1\frac{1}{2}$) inches or more, or which contains any knots of a diameter greater than two and one-half ($2\frac{1}{2}$) inches.

NOTE:—Where diameters are specified in connection with knots, the knot shall be rated on the basis of its average diameter.

SPECIFICATIONS FOR YELLOW PINE POLES.*

Quality of Timber. All poles shall be cut from the best quality of live, straight grained, unbled, long leaf yellow pine. The butt end shall be squared and the top end pointed to an angle of forty-five (45) degrees. The poles shall be sawed octagonal in shape and shall be dressed, with the heart running parallel to the line of the pole. The timber shall be free of decayed or loose knots or clusters of small knots.

Classification and Dimensions. Poles shall be classified according to their butt dimensions into two classes, to be known as Class "A" poles and Class "B" poles, with dimensions for the respective classes as specified in the following table. Where "top" measurement is specified it shall be the diameter at the top of the pole and where "butt" measurement is specified it shall be at the diameter of the butt end of the pole.

*National Electric Light Association Specification.

APPENDIX B—Page II.

Inspection and Rejection. All poles shall be subject to inspection by the purchaser's representative, either in the woods where the trees are felled, or at any point of shipment, or destination. Each pole thus inspected shall be marked according to its length and class with a marking hammer, by the purchaser's representative. All poles failing to meet these specifications shall be rejected.

DIMENSIONS OF POLES IN INCHES (DIAMETER).

LENGTH OF POLES (FEET)	CLASS "A"		CLASS "B"	
	Top	Butt End	Top	Butt End
30	8	11	7	10
35	8	12	7	11
40	8	13	7	12
45	8	14	7	12
50	8	15	7	13
55	8	16	7	14
60	8	17		
65	8	18		

SPECIFICATIONS FOR CREOSOTED YELLOW PINE POLES.*

These specifications are for Class "A," "B" and "C" poles of Southern Yellow Pine treated with Dead Oil of Coal Tar.

Quality of Poles. All poles shall be sound southern yellow pine (longleaf, shortleaf or loblolly yellow pine) squared at the butt, seasoned, straight, well proportioned from butt to top, peeled and afterwards trimmed close. All poles shall be free from large or decayed knots. All poles shall be cut from live timber.

It is desired that all poles be well air seasoned before treatment and such poles shall be treated in accordance with the requirements for treating seasoned timber contained in the "Specifications for Creosoting Timber" referred to in Section 9. The poles shall not be held for seasoning, however, up to the point where local experience shows that sapwood decay would begin.

*American Telephone & Telegraph Company Specification.

APPENDIX B—Page 12.

Unseasoned poles shall be treated in accordance with the requirements for treating unseasoned timber contained in the above mentioned specifications.

All poles shall be sufficiently free from adhering "inner bark" before treatment to permit the penetration of the oil. If the "inner bark" is not satisfactorily removed when the pole is peeled, the pole shall either be shaved, or be allowed to season until the "inner bark" cracks and tends to peel off of the surface of the pole.

Dimensions. The dimensions of the poles shall not be less than those given in the following table:

DIMENSIONS OF POLES IN INCHES (CIRCUMFERENCE).

LENGTH OF POLES (FEET)	CLASS "A" 6 ft. from Butt	CLASS "B" 6 ft. from Butt	CLASS "C" 6 ft. from Butt
25	33	30	28½
30	35	32	30½
35	38	34	32
40	40	36	34
45	42½	38	36
50	44½	40	38
55	47	42½	40
60	49	44½	42
65	51	47	44
70	53	49	46
75	55	51	
80	57		

No Class "A" poles having a top circumference of less than twenty-two (22) inches will be accepted.

No Class "B" poles having a top circumference of less than twenty (20) inches will be accepted.

No Class "C" poles having a top circumference of less than eighteen (18) inches will be accepted.

Framing of Poles. Before the poles are subjected to the creosoting process they shall be framed, as ordered.

APPENDIX B—Page 13.

The tops of all poles shall be roofed at an angle of ninety (90) degrees.

All Class "A" poles shall have eight (8) gains, all Class "B" poles shall have four (4) gains and Class "C" poles shall have two (2) gains.

The gains shall be located on the side of the pole with the greatest curvature, and on the convex side of the curve. The faces of all gains shall be parallel. Each gain shall be four and one-half ($4\frac{1}{2}$) inches wide and one-half ($\frac{1}{2}$) inch deep, spaced twenty-four (24) inches on centers. The center of the top gain shall be twelve (12) inches from the apex of the gable. A twenty-one-thirty-second ($21/32$) inch hole shall be bored through the pole at the center of each gain perpendicular to the plane of the gain.

Inspection. The quantity of dead oil of coal tar forced into the poles shall be determined by tank measurements, and by observing the depth of penetration of the oil into the pole. In the case of poles having a growth of sapwood not less than one and one-half ($1\frac{1}{2}$) inches in thickness, the depth of penetration shall be not less than one and one-half ($1\frac{1}{2}$) inches. In the case of poles having a growth of sapwood less than one and one-half ($1\frac{1}{2}$) inches in thickness, the dead oil of coal tar shall penetrate through the sapwood and into the heartwood.

Depth of penetration shall be determined by boring the pole with a one (1) inch auger. The right is reserved to bore for this purpose, two (2) holes at random about the circumference, one (1) hole five (5) feet from the butt and one (1) hole ten (10) feet from the top. After inspection each bore hole shall be first filled with hot dead oil of coal tar, and then with a close fitting creosoted wooden plug.

The rejection of any pole on the score of insufficient penetration shall not preclude its being retreated and again offered for inspection.

APPENDIX C.

CONDUCTOR SAGS.

The sag curves, Pages 92 to 110, inclusive, are divided into two sections:

First: Those showing the minimum sag under normal conditions (sixty (60) degrees Fahrenheit, no wind or ice loading) to which conductors may be strung so that when loaded with the specified loads (zero (0) degrees Fahrenheit, eight (8) pounds wind and one-half ($\frac{1}{2}$) inch of ice) the total tension will not exceed one-half ($\frac{1}{2}$) the ultimate strength of the conductors. (Section III, Paragraph 316, Section VI, Paragraph 618.)

Second: Those showing the minimum sag under normal conditions (sixty (60) degrees Fahrenheit, no wind or ice) to which conductors may be strung so that when the specified loads (zero (0) degrees Fahrenheit, eight (8) pounds wind and one-half ($\frac{1}{2}$) inch of ice) are imposed upon them the total tension will not exceed one-half ($\frac{1}{2}$) the ultimate strength of the conductors, with a maximum limit of 2,000 pounds. (Section III, Paragraph 326, Section VI, Paragraph 628.)

Sags For Unequal Spans, Level Supports and Normal Conditions.

When the crossing and adjoining spans are of different lengths it is not possible to so string the conductors so as to make both the normal tension and the loaded tension balance in the several spans. This condition should be met by selecting a sag for the **longest** span not less than that shown in the accompanying curves, Pages 96 to 114, inclusive. (Either group, as the case may be.)

The sags for the other spans should then be made proportional to the square of the **longest** span and the span considered. The total normal tension in each of the spans will then balance and the total tension under loaded conditions will be slightly less in the short spans than in the longest span.

APPENDIX C—Page 2.

Example:

Assume—A crossing span length of 300 ft.

Adjoining spans of 400 ft. and 200 ft., respectively.

Conductors No. 0 A. W. G., copper, hard drawn, solid, bare.

Sag from curve, Page 96, for a 400 ft. span is 8.9 ft.

Making the sags in the other spans proportional to the square of the spans; the sag in the 300 ft. span will be,

$$\frac{(300)^2 \times 8.9}{(400)^2} = 5.0 \text{ ft.}$$

The sag in the 200 ft. span will be,

$$\frac{(200)^2 \times 8.9}{(400)^2} = 2.22 \text{ ft.}$$

Sags for Supports at Different Elevations.

The sag curves have been based on the supports being at the same elevation. This condition is not always possible. The curve on Page 115 covers the correction of the sag curves to care for this condition.

The use of this correction may best be illustrated by taking a concrete case:

Example:

Assume—A span of 400 ft.

A difference in level of supports of 6 ft.

Conductors No. 0 A. W. G., copper, hard drawn, solid, bare.

The curve, Page 96, requires a sag of 8.9 ft.

The ratio of difference in level of supports divided by the sag is 6.0 divided by 8.9 equals 0.674, which is the ratio marked h/s on curve, Page 111. The multiplier C for this ratio is 0.692. Therefore the sag below the lowest point of support is,

$$0.692 \times 8.9 \text{ equals } 6.16 \text{ ft.}$$

APPENDIX C—Page 3.

If the sag is to be measured from the higher support, the sag below the lower support may be obtained as above and the difference in elevation of the supports added thereto, or the sag below the higher support is,

$$6.16 + 6.0 \text{ equals } 12.16 \text{ ft.}$$

Sag Correction for Temperature.

The curves, Pages 115 to 119, inclusive, cover the correction of sags for stringing temperatures other than that for which the sag curves were calculated. These figures cover the commercial range of stringing conditions for temperatures at time of stringing, varying between twenty (20) degrees Fahrenheit and 100 degrees Fahrenheit, and for spans of from 100 feet to 1000 feet, inclusive, in 100 foot steps, with the exception that a 150 foot span has also been included. They represent **average** values for each degree Fahrenheit difference between actual stringing temperatures and the temperature for which the curves were calculated; that is sixty (60) degrees Fahrenheit. The correction for twenty (20) degrees Fahrenheit above sixty (60) degrees Fahrenheit is different from the correction for twenty (20) degrees Fahrenheit below sixty (60) degrees Fahrenheit. The results have therefore been plotted for temperatures above and for temperatures below sixty (60) degrees Fahrenheit. The correction for temperatures greater than sixty (60) degrees Fahrenheit are to be **added** to the normal sags and **subtracted** for temperatures less than sixty (60) degree Fahrenheit.

The use of these corrections may be illustrated by assuming a specific case:

Example:

Assume—A span of 400 ft.

Conductors No. 0 A. W. G., copper, hard drawn, solid, bare.

Stringing temperature 75° F.

Minimum normal sag (Page 96) is 8.9 ft.

Difference between stringing temperature and normal temperature is 15° F.

The ratio for sag divided by span is 0.0223.

APPENDIX C—Page 4.

The correction per degree Fahrenheit for this ratio for temperatures greater than 60° for a span of 400 ft. (Page 113) is 0.0258.

Total correction for 15° F. difference is

$$15 \times 0.0258 \text{ equals } 0.387, \text{ or say } 0.39.$$

Then the corrected sag is 8.9 plus 0.39 equals 9.29 ft.

If some other span than those covered by specific curves are used the correction may be obtained by interpolation between curves.

Determination of Amount of Sag for Various Points in a Span.

The sag curves, on Pages 96 to 114, inclusive, show for wires of different sizes and materials the value of the centre sag at which these wires should be strung under normal conditions to have the assumed factors of safety under the designated loaded conditions. At times it is desirable to know, not only the amount of the sag at the centre of the span, but also the amount of the sag at some other point in the span. This is necessary, for example, in obtaining the clearance over other wires where the point of crossing between the crossing span and the wires crossed, occurs, not at the centre of the crossing span, but at some other point.

On Page 120, there is given a curve by means of which, given the amount of the centre sag, there can be determined the amount of the sag at any other point in the span. This curve gives the value of the sag at all points on the catenary curve, expressed in per cent. of the centre sag. The use of the curve shown on this figure is as follows:

Example:

Assume—A span of 400 ft.

A centre sag, determined from the sag tables, of 8.9 ft.

The crossing span crosses over a Class "C" Line, on which the top wire at the point of this crossing has an elevation of 25 ft.

APPENDIX C—Page 5.

This point of crossing to be 120 ft. from the nearest support of the crossing conductor, and that a minimum vertical clearance of 6 ft. 6 in. is required at the point of crossing.

Required—At what height must the crossing conductor be supported in order that this required vertical clearance shall be obtained?

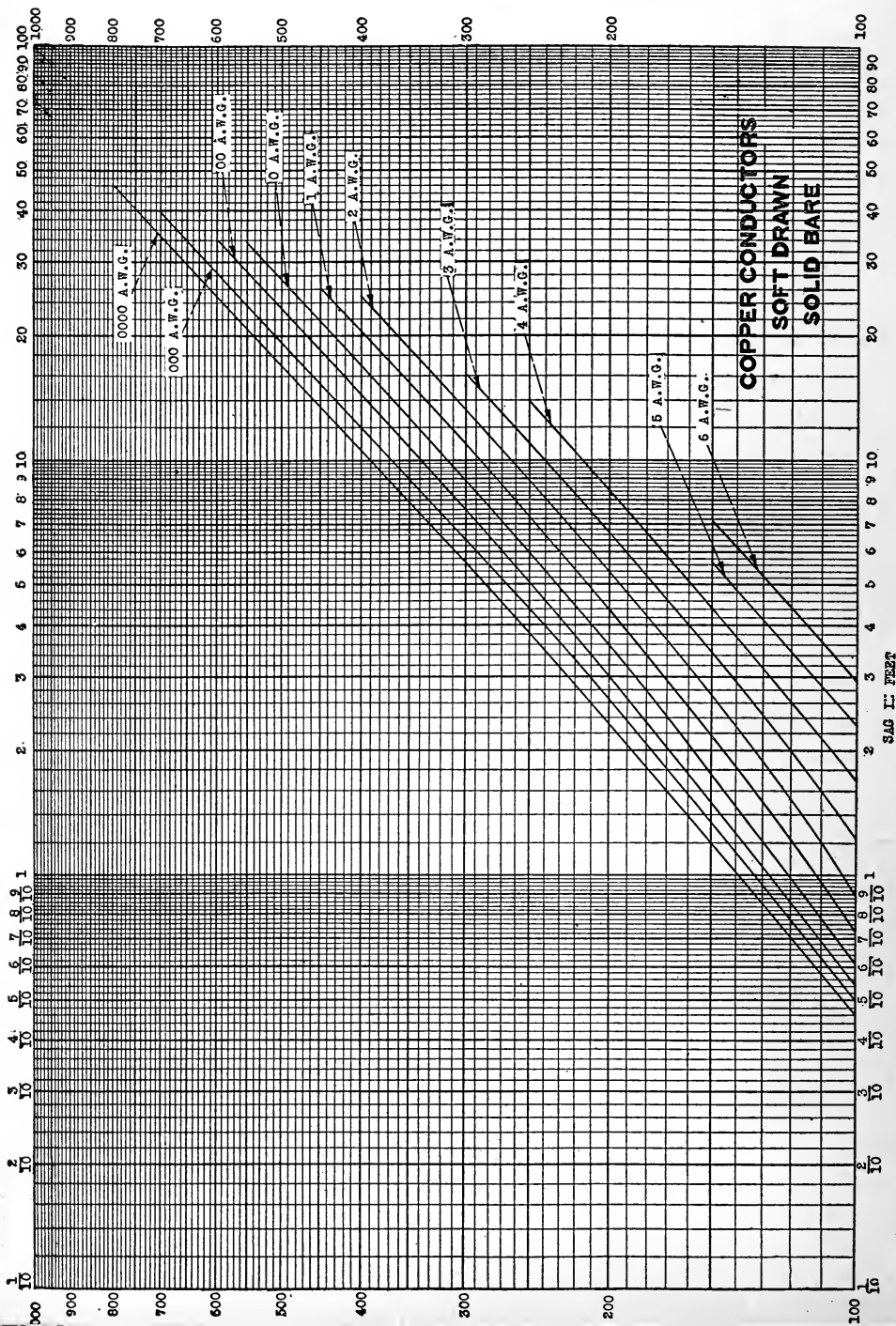
As the span length is 400 ft., and the distance from the nearest support to the point of crossing is 120 ft., this distance is 30 per cent. of the span length. From the curve, Page 116, the value of the sag at this point is 84 per cent. of the centre sag. The sag at this point, therefore, equals $8.9 \times .84 = 7.47$ ft.

Therefore, the required elevation of the crossing conductor at its point of support is equal to the height of the Class "C" wires crossed (25 ft.), plus the minimum vertical clearance required (6.5 ft.), plus the sag of the conductor at the point of crossing (7.47 ft.)

$$25 \text{ ft.} + 6.5 \text{ ft.} + 7.47 \text{ ft.} = 38.97 \text{ ft.}$$

APPENDIX C—Page 6.

Conductor Sags—Copper—Soft Drawn—Solid—Bare.



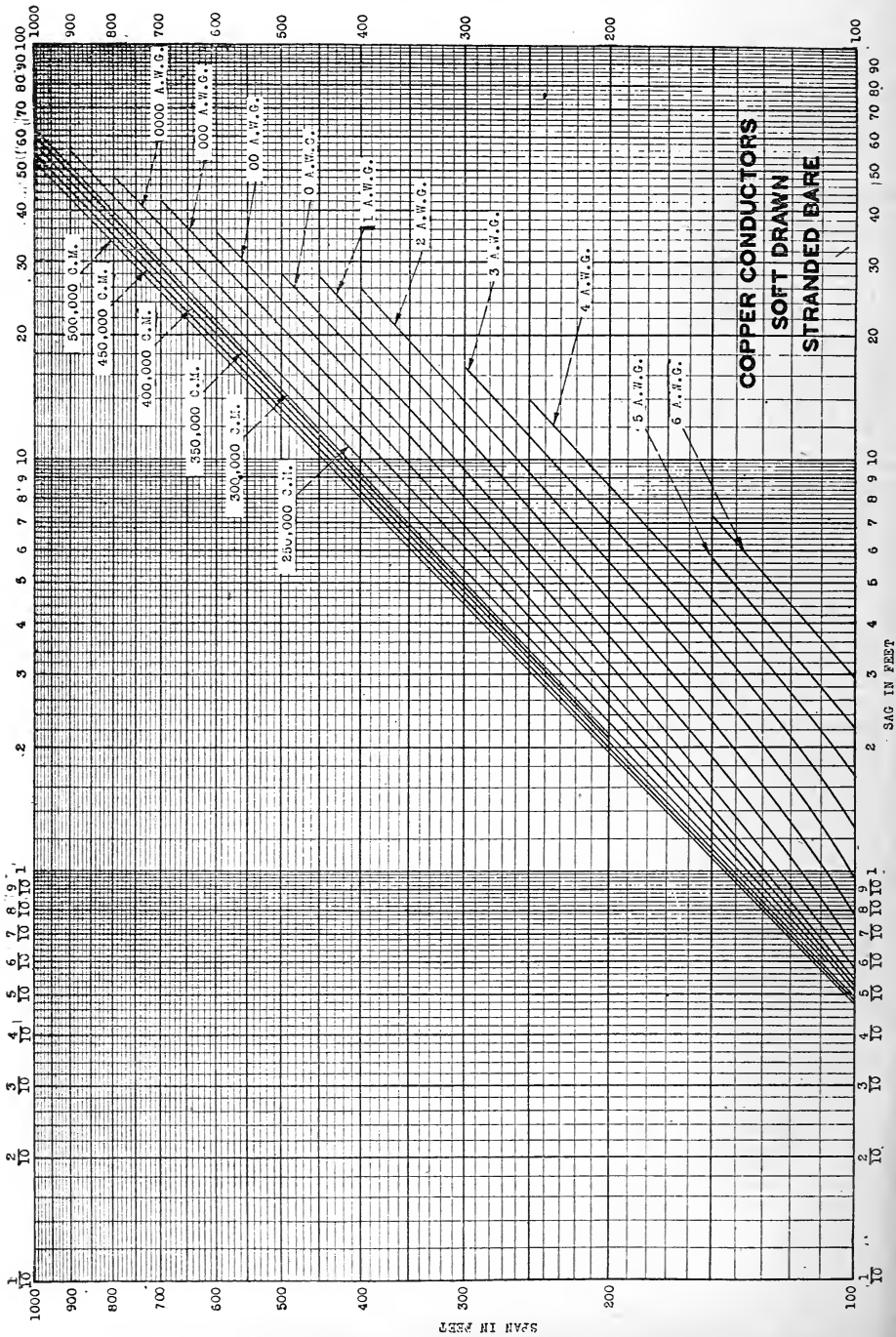
COPPER CONDUCTORS
SOFT DRAWN
SOLID WEATHER PROOF

The chart is a log-log plot used to determine the sag of copper conductors. The vertical axis represents the weight of the conductor in A.W.G. (American Wire Gauge), ranging from 100 to 1000. The horizontal axis represents the sag in feet, ranging from 1 to 100. Diagonal lines are drawn across the grid, each representing a specific conductor weight. The lines are labeled as follows:

- 0000 A.W.G.
- 000 A.W.G.
- 00 A.W.G.
- 0 A.W.G.
- 1 A.W.G.
- 2 A.W.G.
- 3 A.W.G.
- 4 A.W.G.
- 5 A.W.G.
- 6 A.W.G.

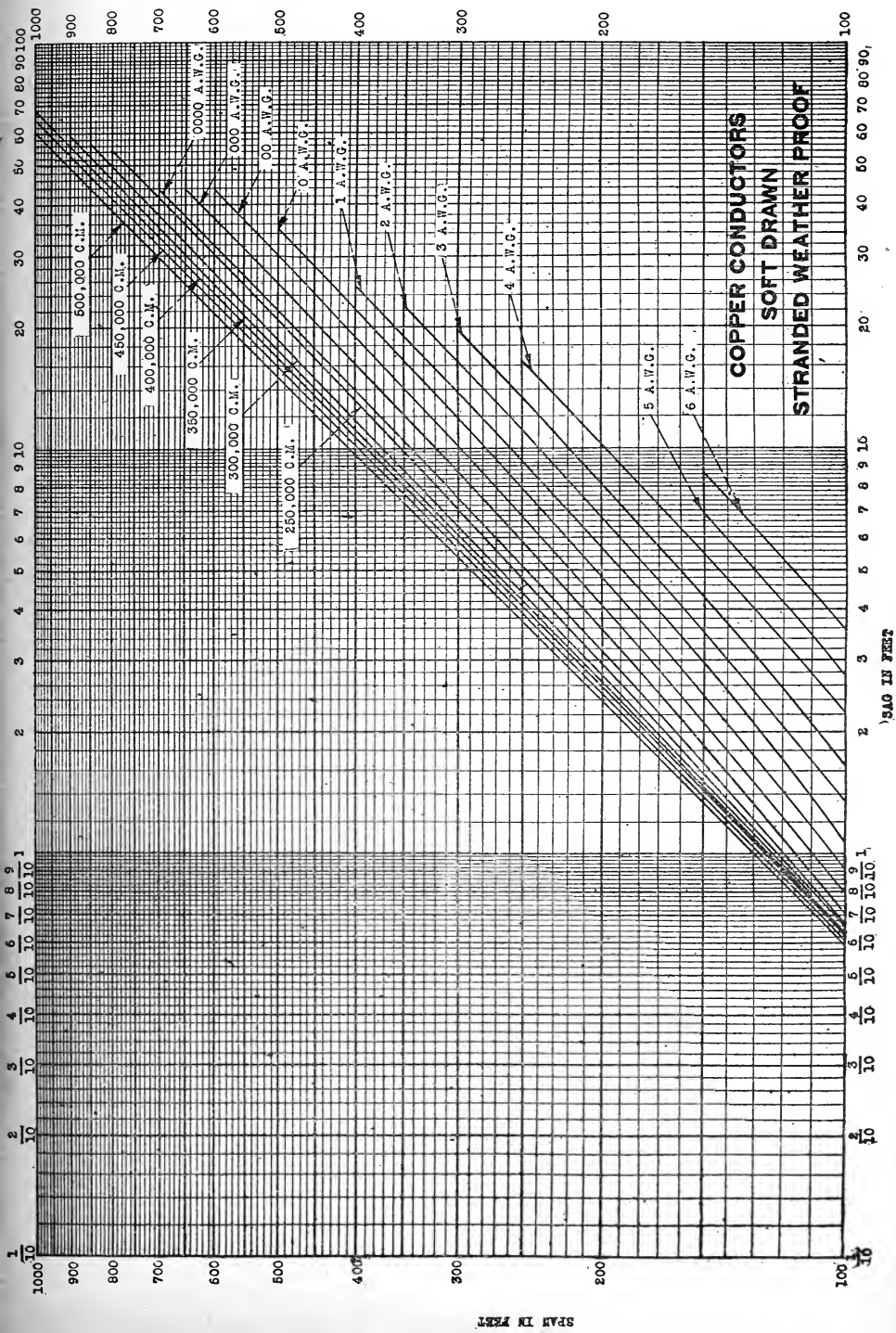
To use the chart, one would find the conductor weight on the vertical axis, follow the corresponding diagonal line, and then read the sag value on the horizontal axis.

Conductor Sags—Copper—Soft Drawn—Stranded—Bare.

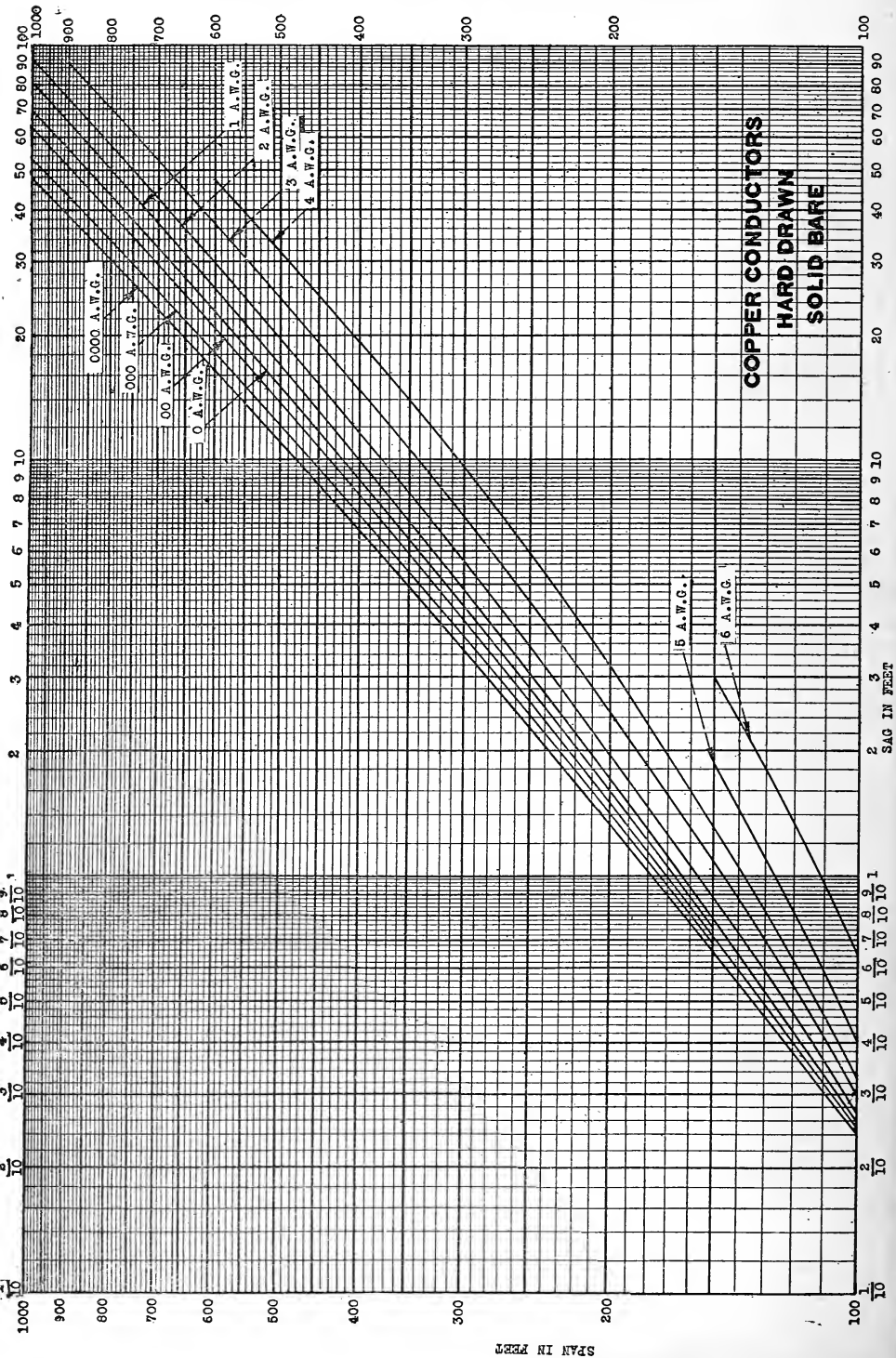


APPENDIX C—Page 9.

Conductor Sags—Copper—Soft Drawn—Stranded—Weatherproof.

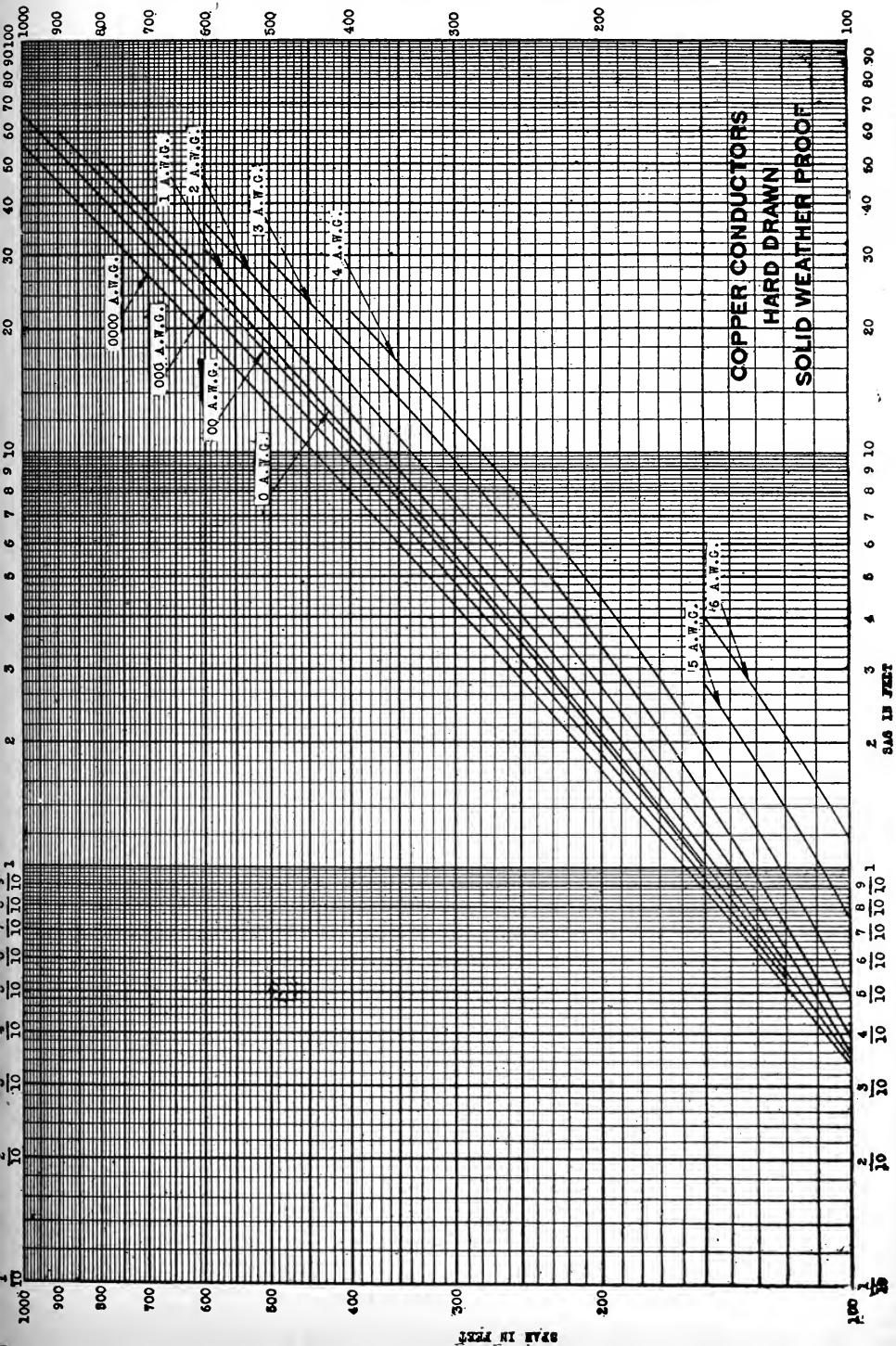


Conductor Sags—Copper—Hard Drawn—Solid—Bare.



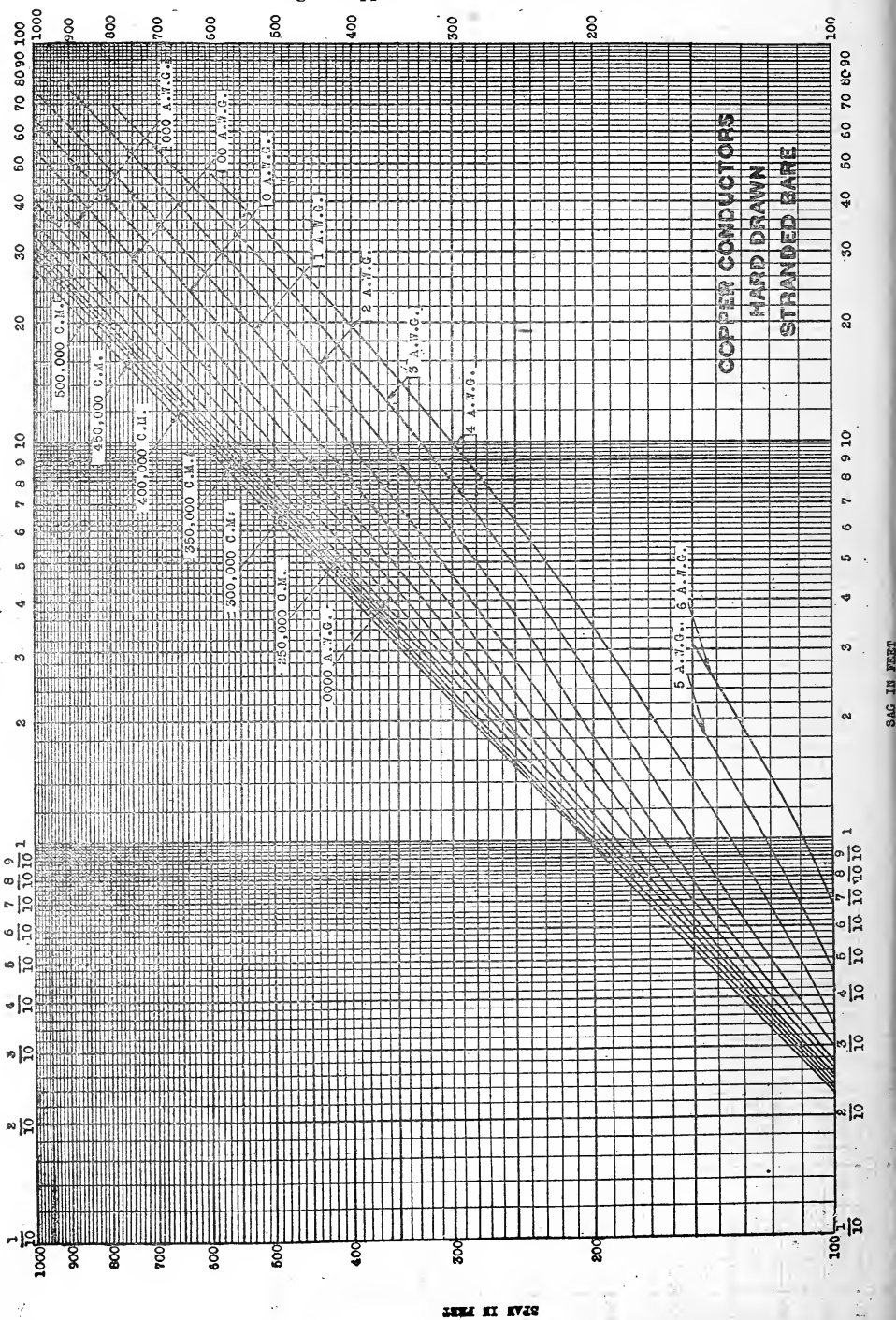
APPENDIX C—Page 11.

Conductor Sags—Copper—Hard Drawn—Solid—Weatherproof.



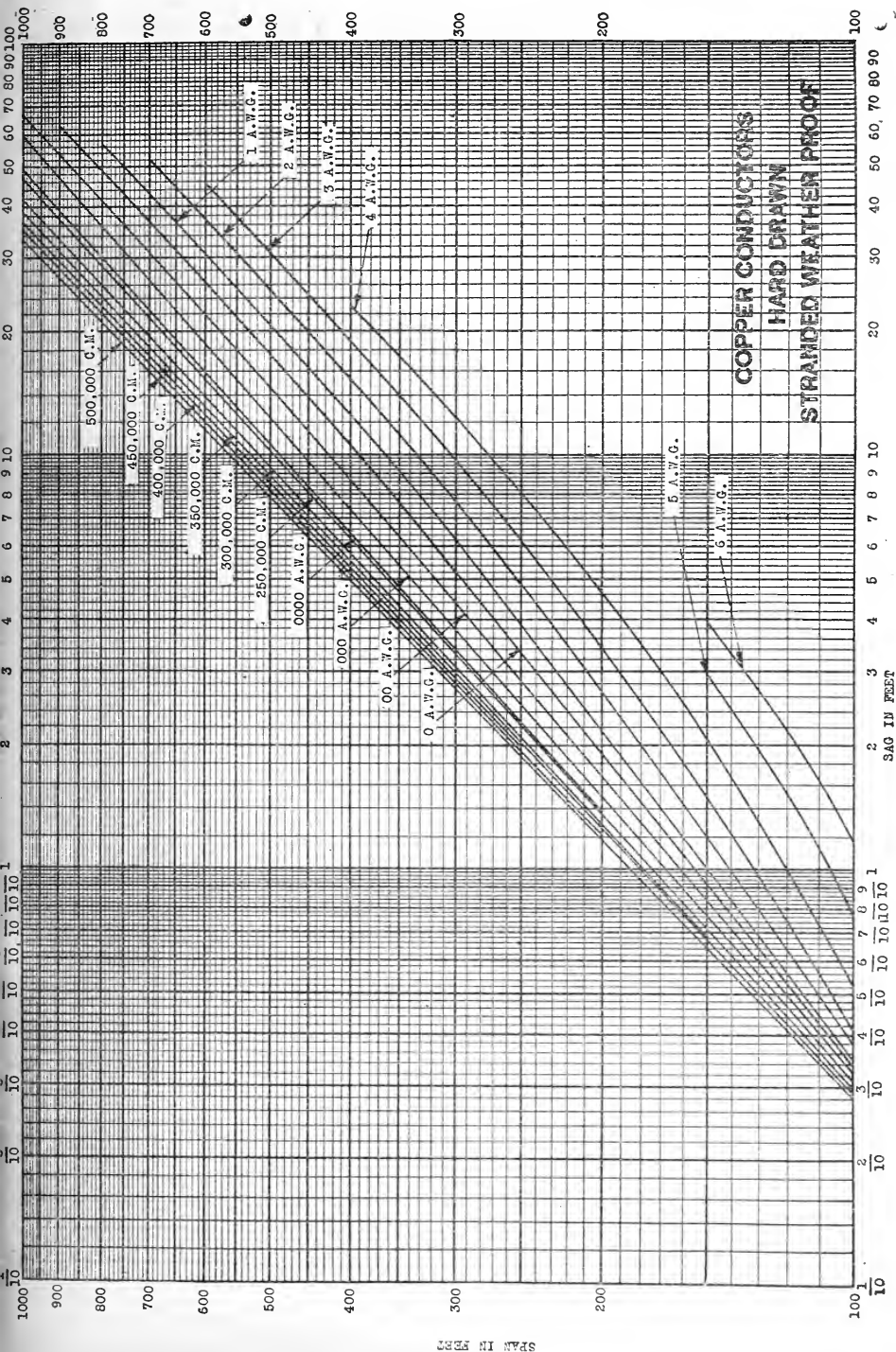
APPENDIX C—Page 12.

Conductor Sags—Copper—Hard Drawn—Stranded—Bare.

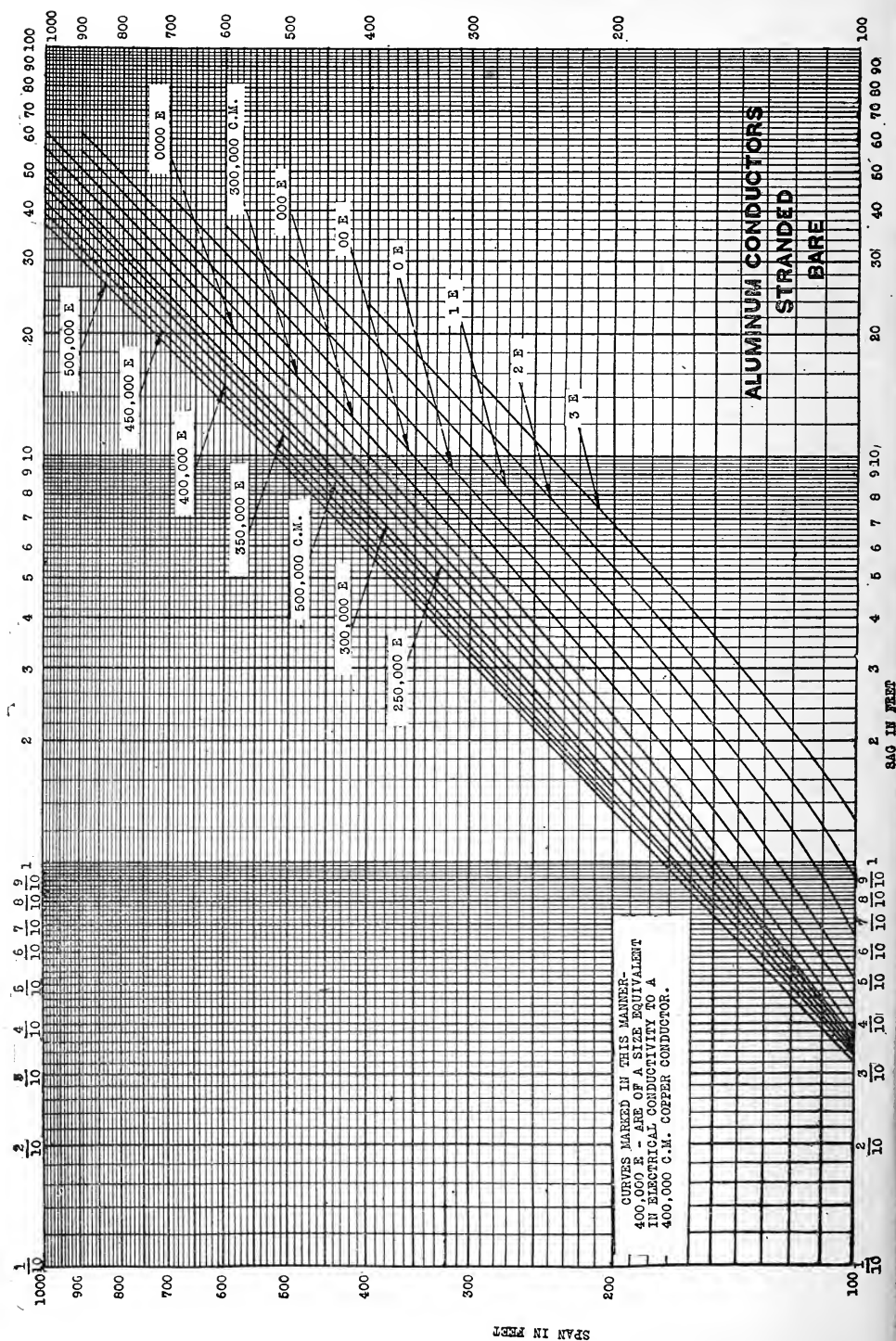


APPENDIX C—Page 13.

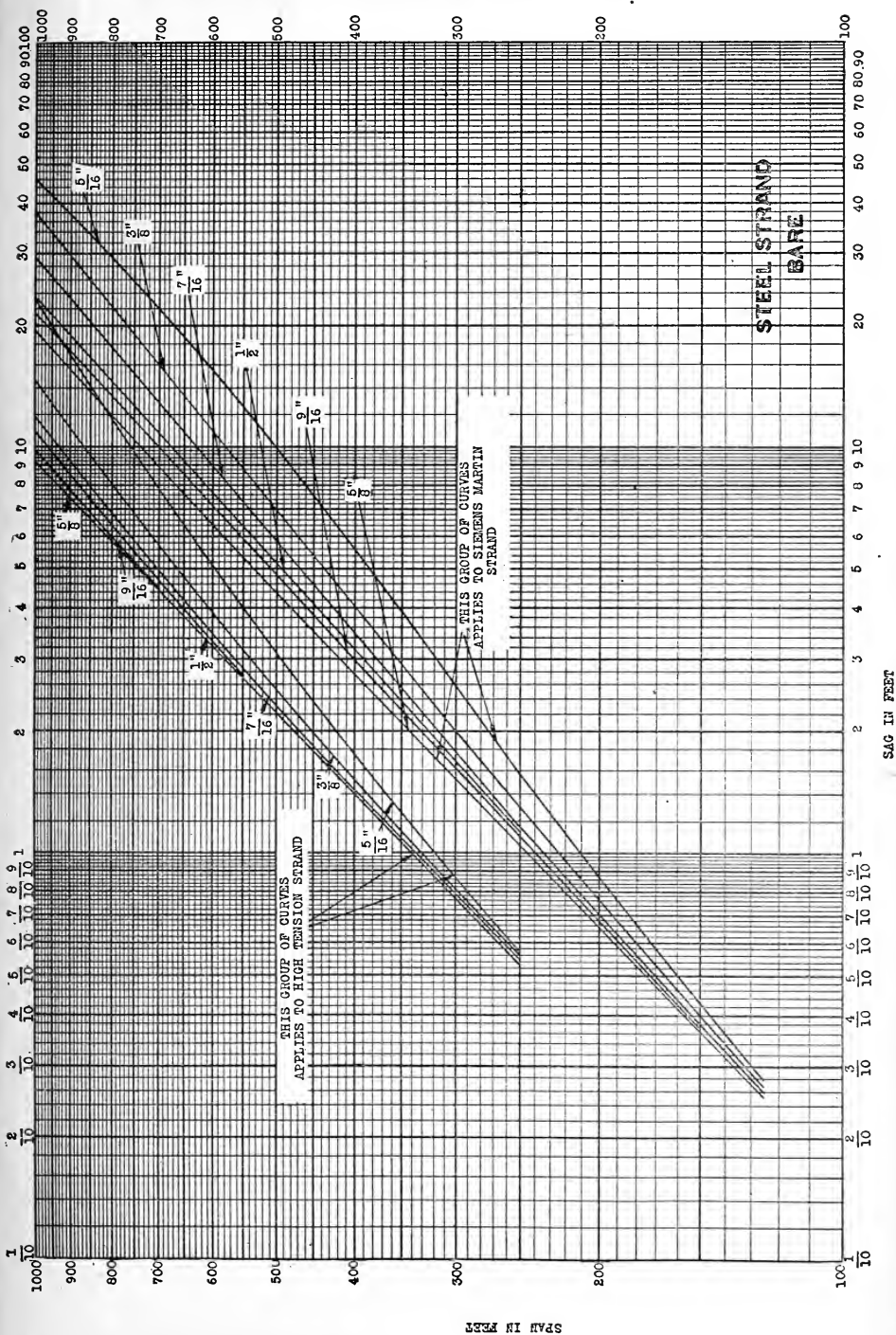
Conductor Sags—Copper—Hard Drawn—Stranded—Weatherproof.



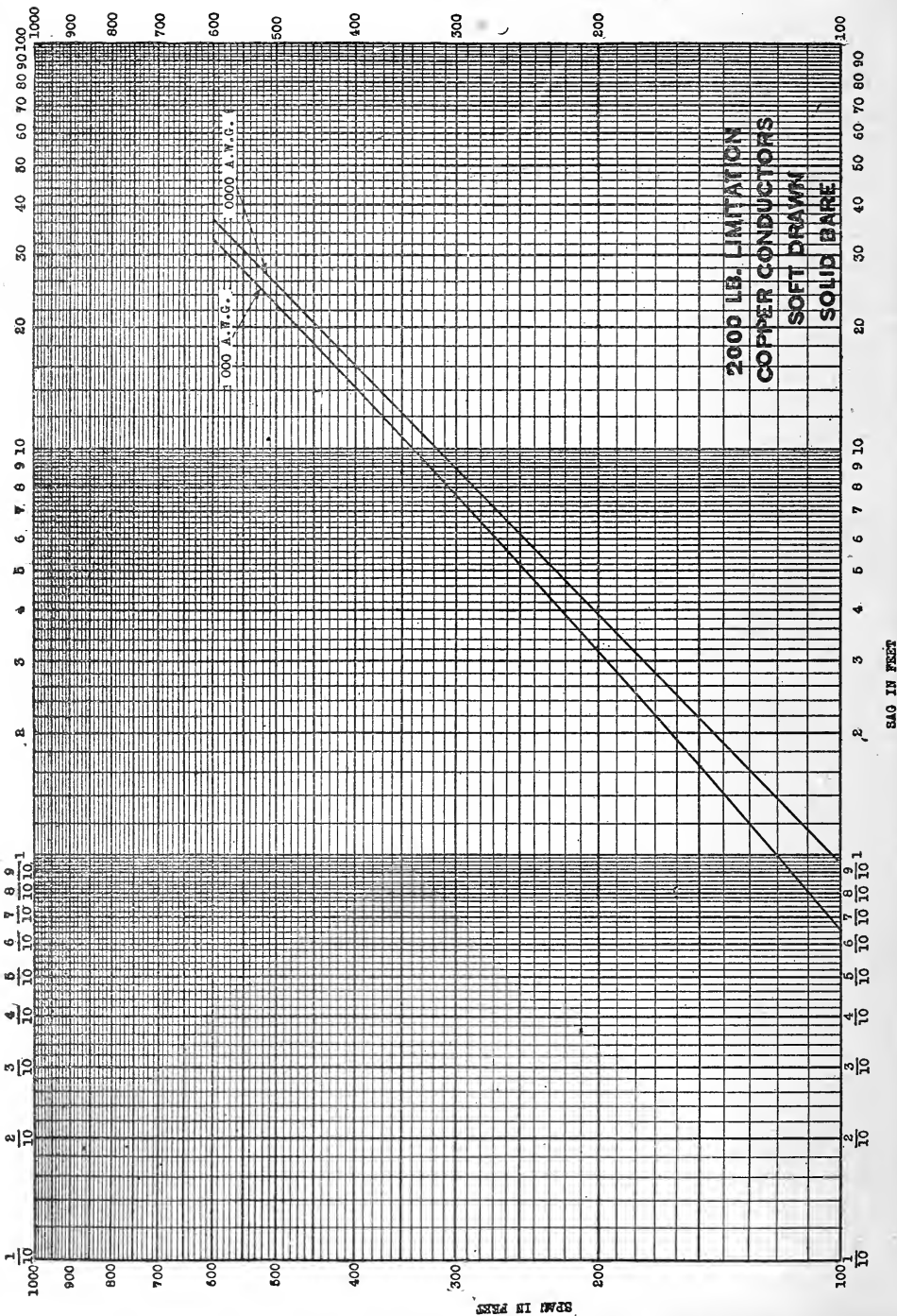
Conductor Sags—Aluminum—Stranded—Bare.



APPENDIX C—Page 15.
Conductor Sags—Steel Strand—Bare.

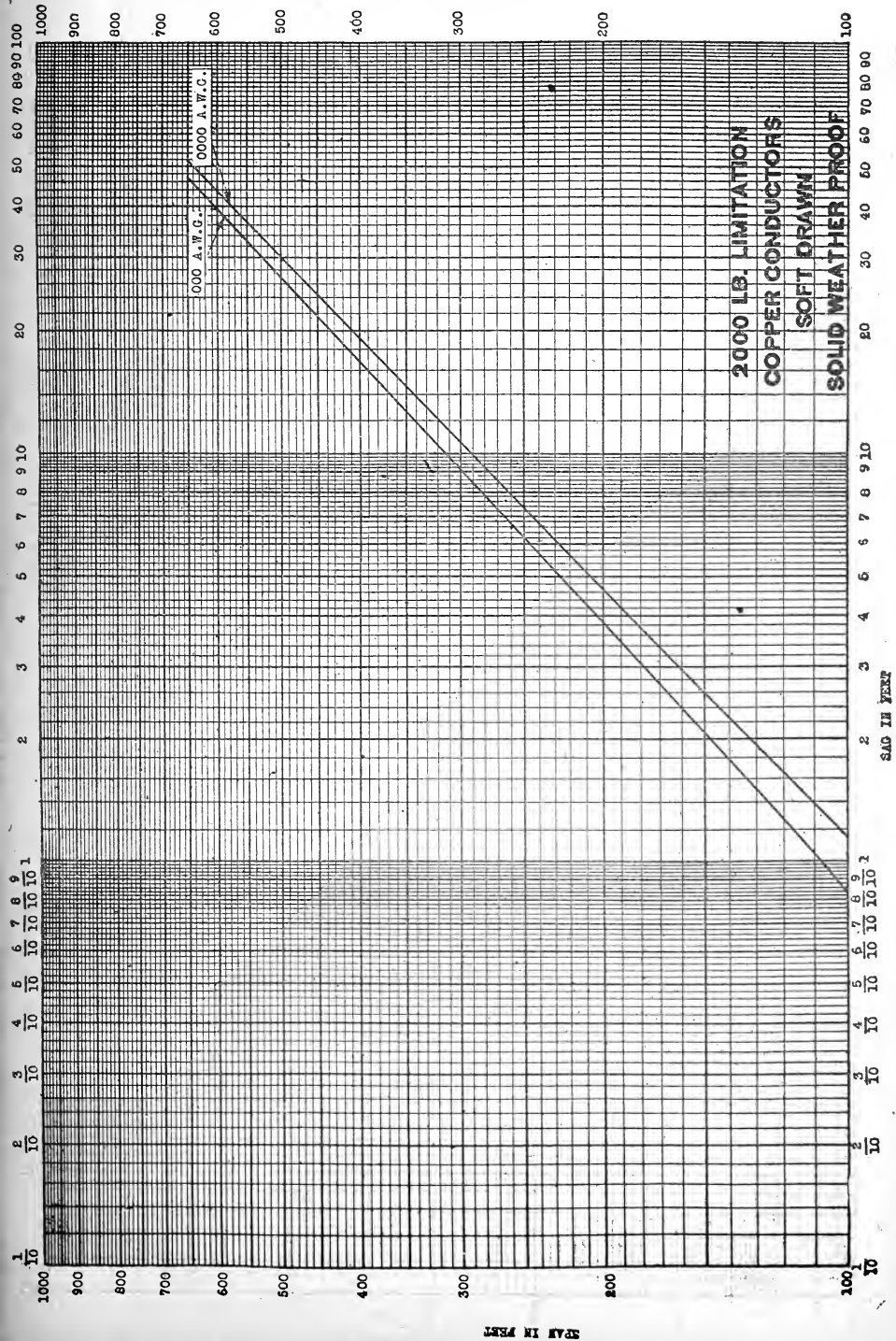


Conductor Sags—2000 Lbs. Limitation—Copper—Soft Drawn—
Solid—Bare.



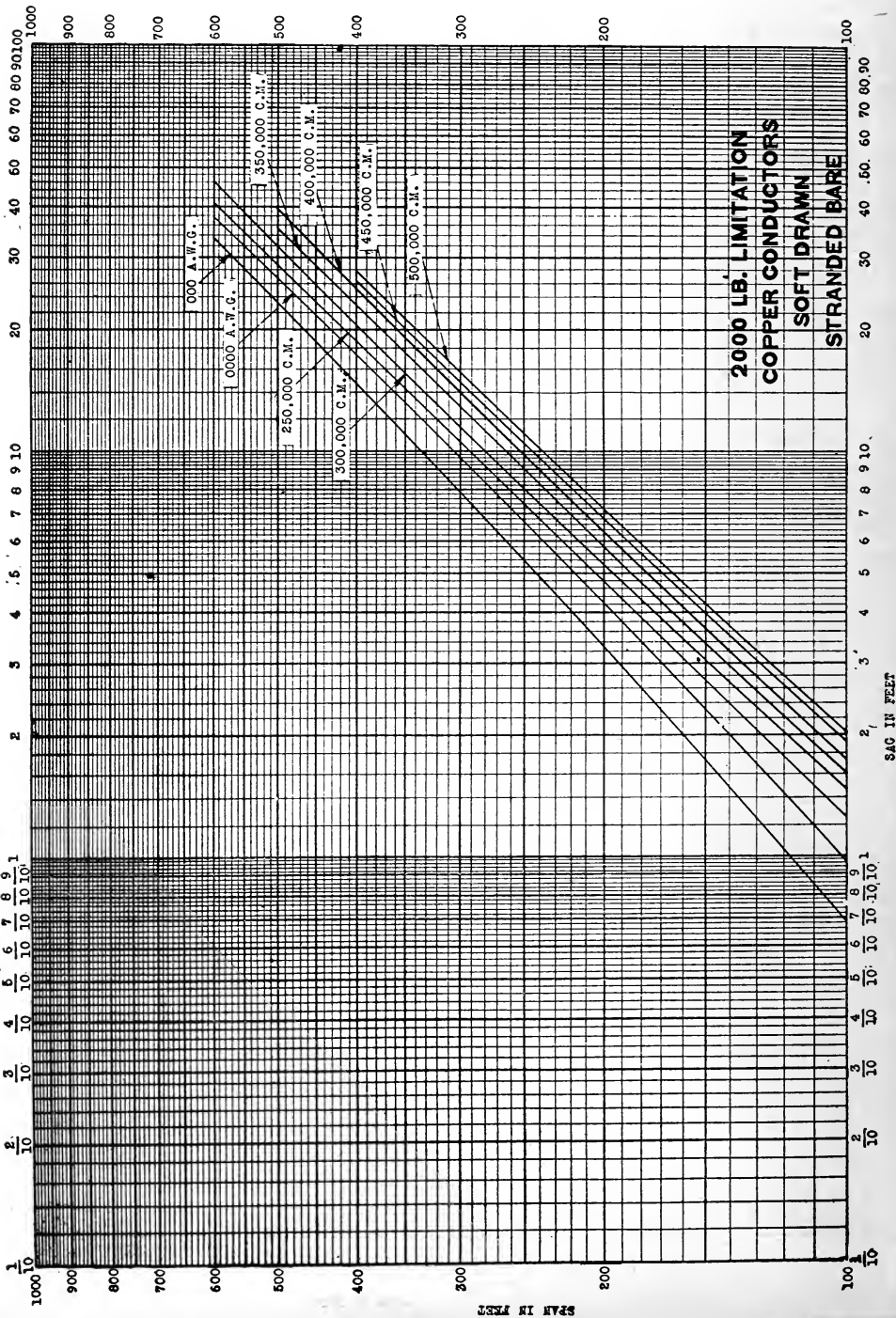
APPENDIX C—Page 17.

Conductor Sags—2000 Lbs. Limitation—Copper—Soft Drawn—
Solid—Weatherproof.



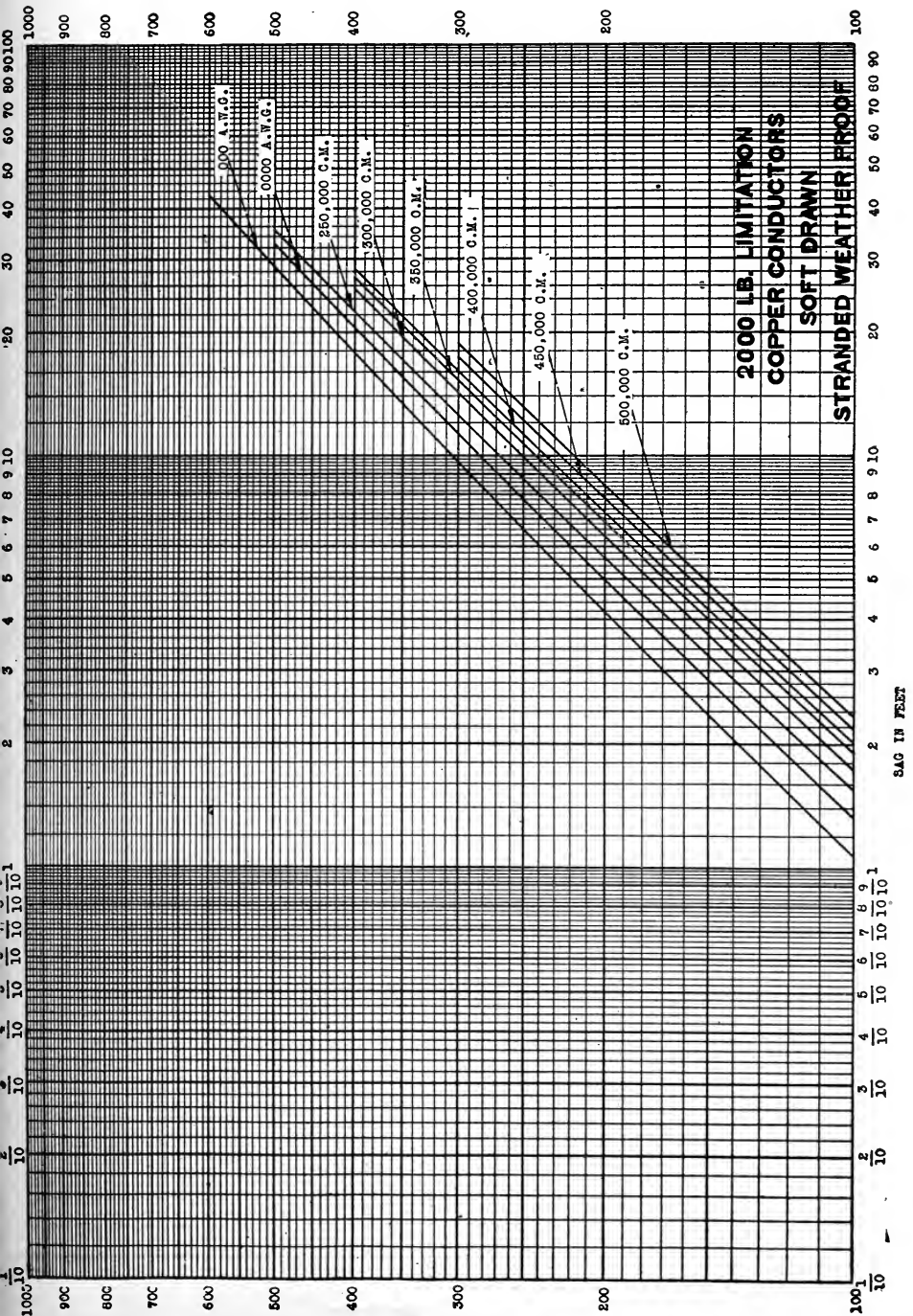
APPENDIX C—Page 18.

Conductor Sags—2000 Lbs. Limitation—Copper—Soft Drawn—
Standard—Bare.



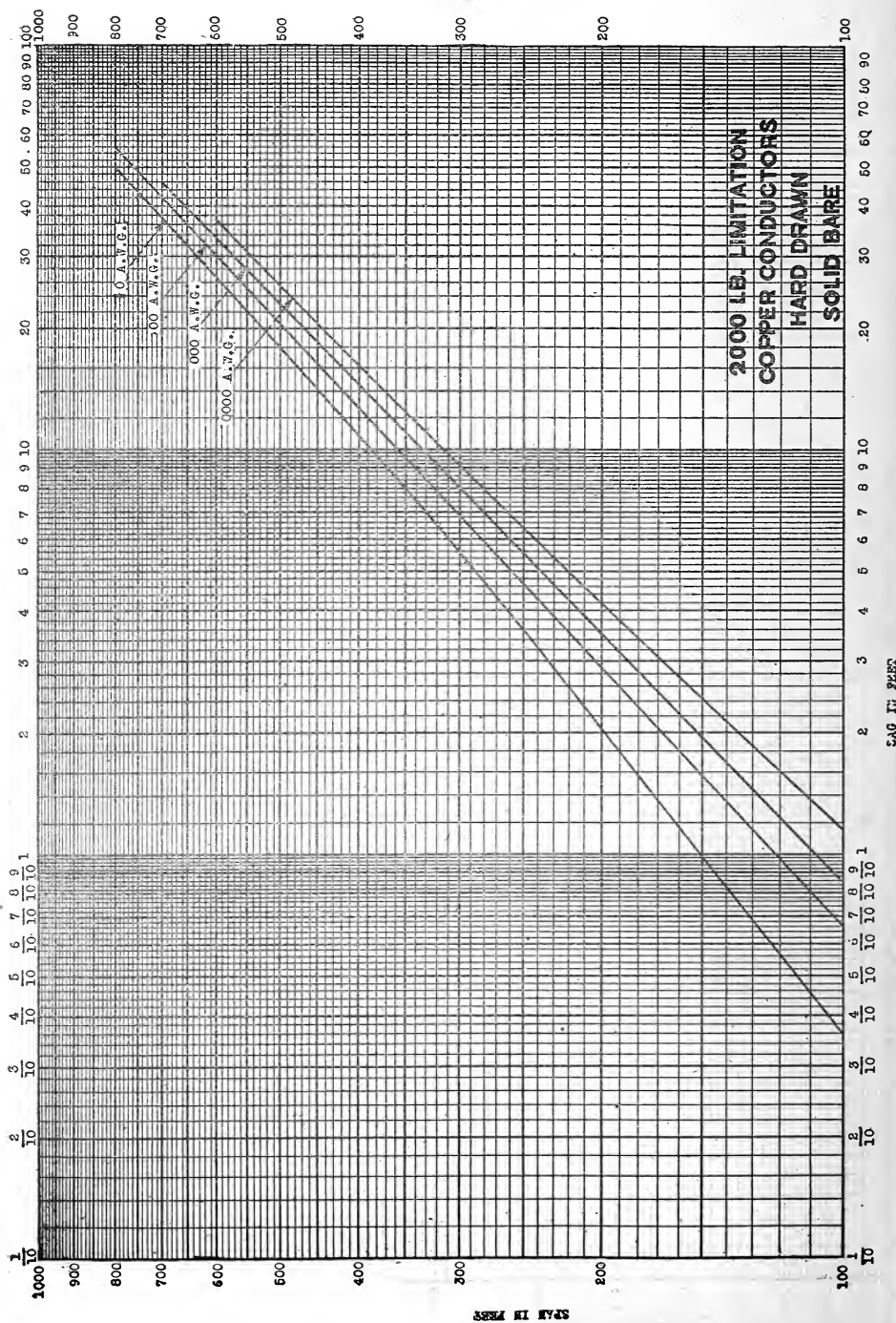
APPENDIX C—Page 19.

Conductor Sags—2000 Lbs. Limitation—Copper—Soft Drawn—
Stranded—Weatherproof.



APPENDIX C—Page 20.

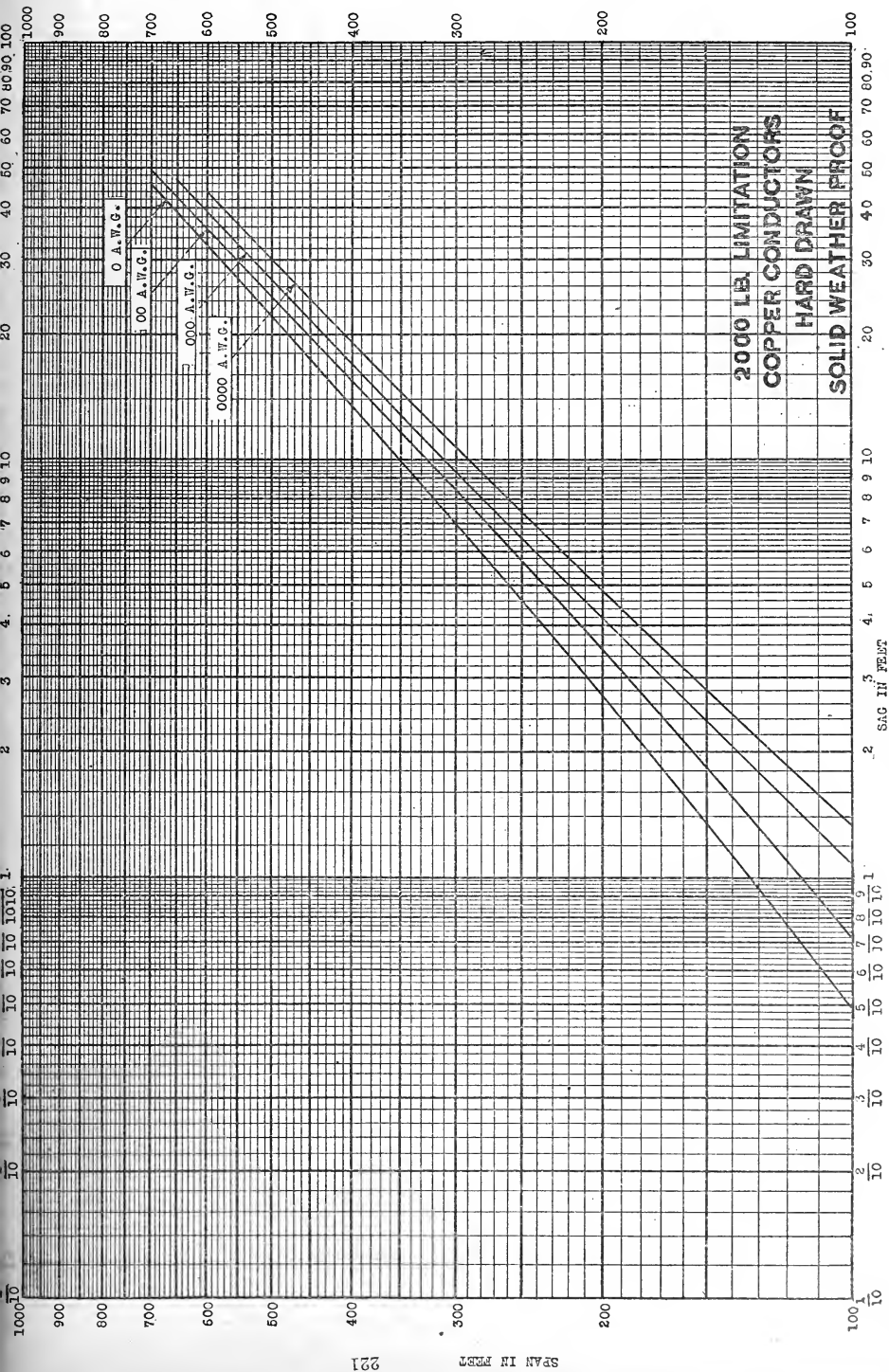
Conductor Sags—2000 Lbs. Limitation—Copper—Hard Drawn—
Solid—Bare.



APPENDIX C—Page 21.

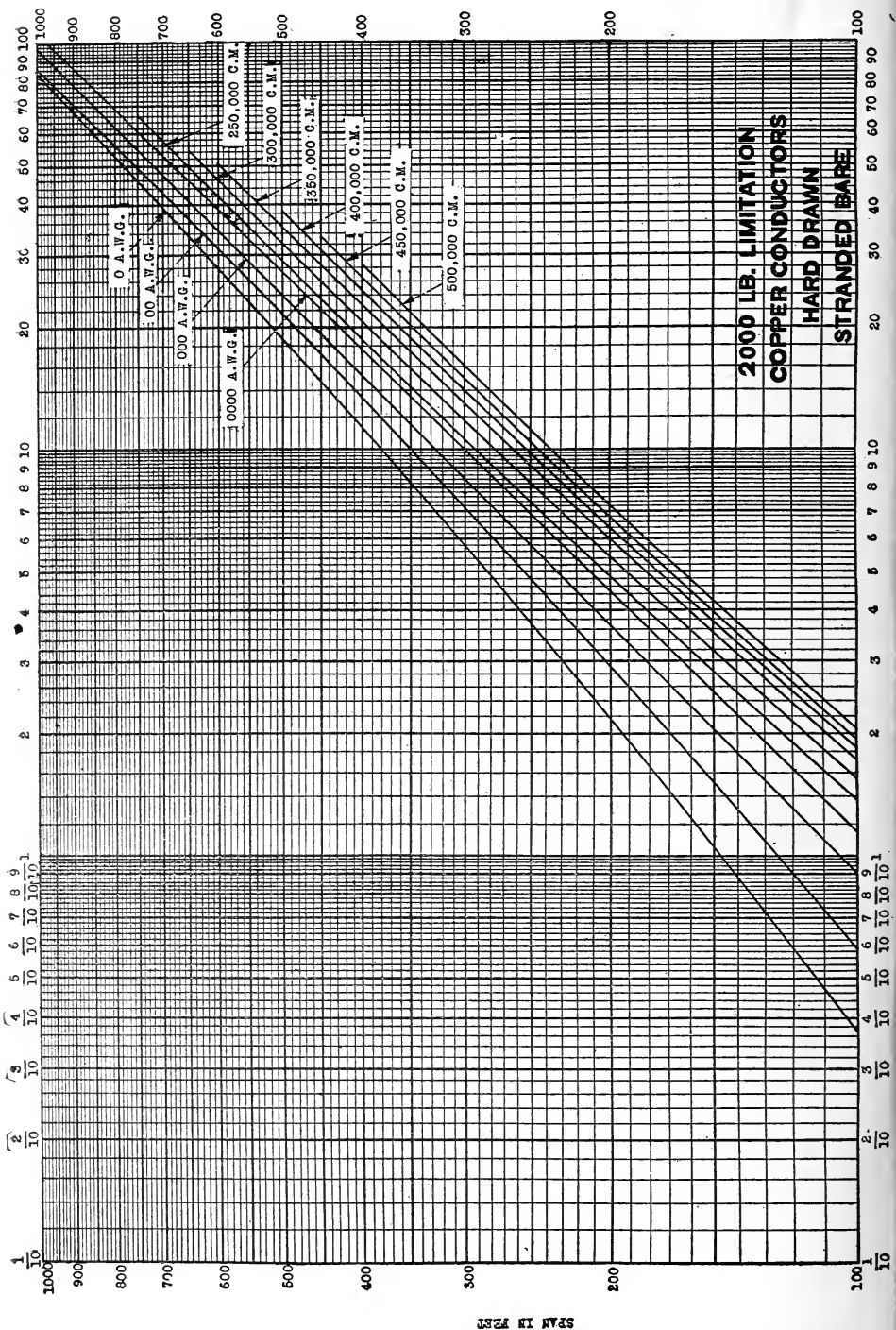
Solid—Weatherproof.

Conductors Sags—2000 Lbs. Limitation—Copper—Hard Drawn—



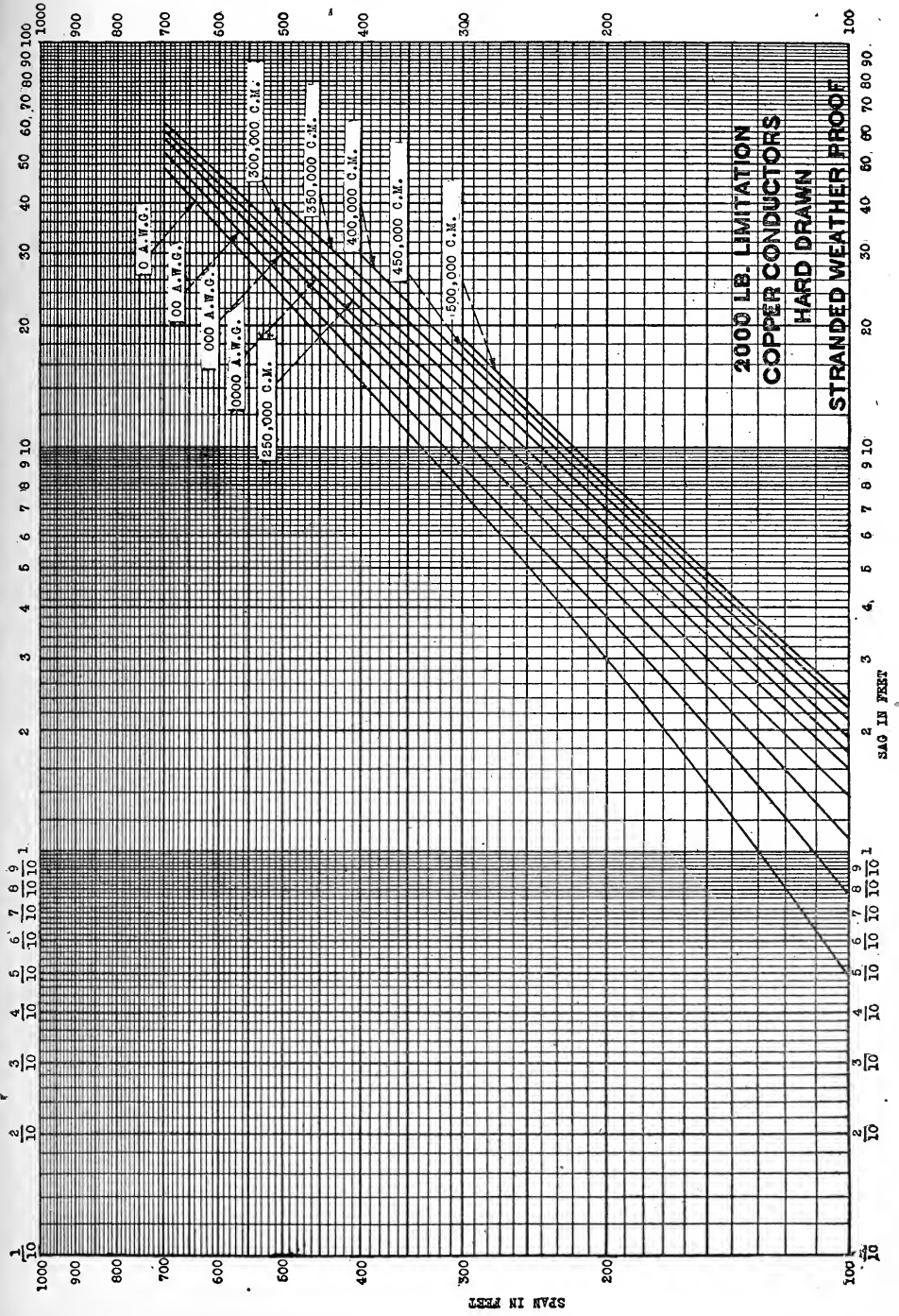
APPENDIX C—Page 22.

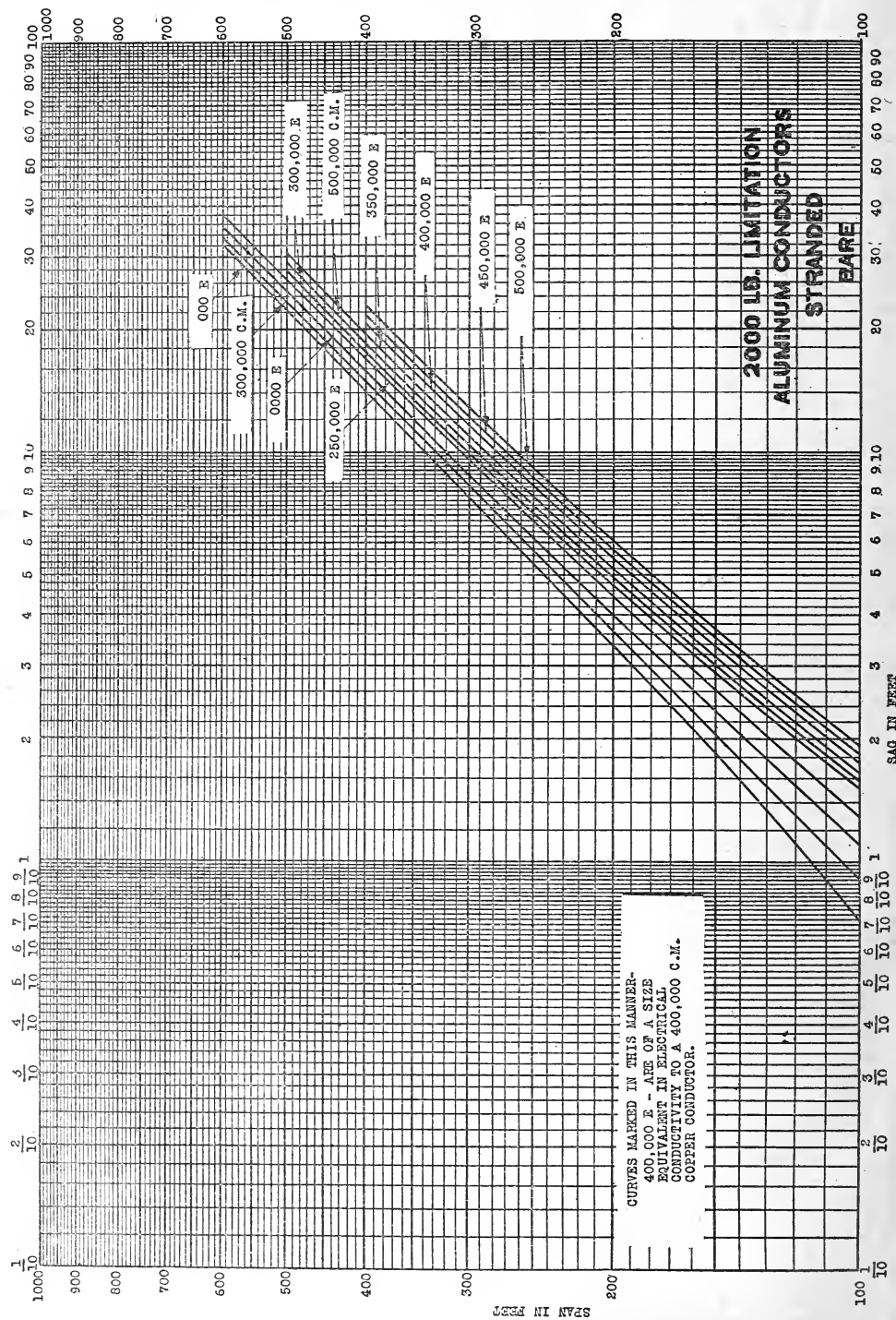
Conductor Sags—2000 Lbs. Limitation—Copper—Hard Drawn—Stranded—Bare.



APPENDIX C.—Page 23.

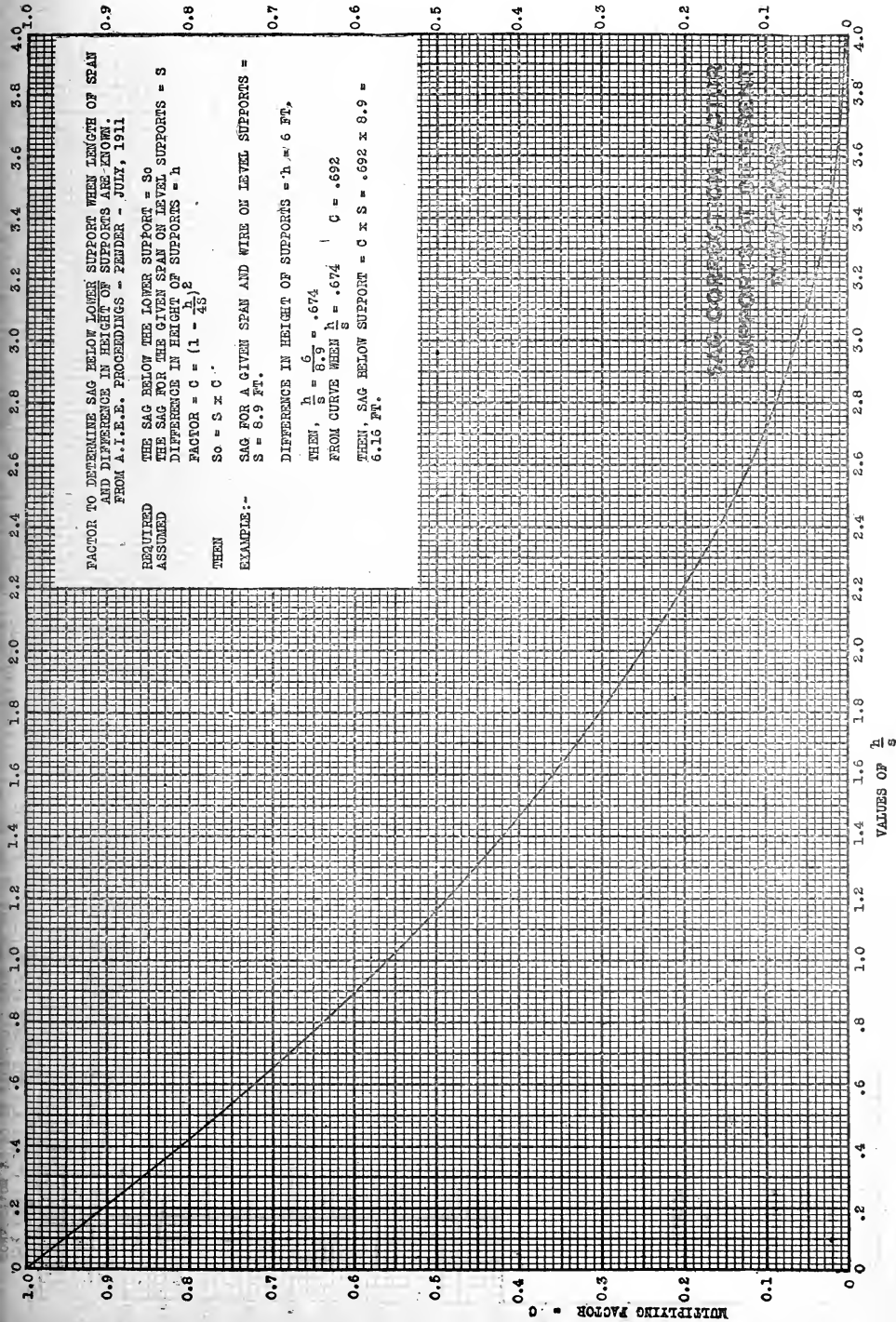
Conductor Sags—2000 Lbs. Limitations—Copper—Hard Drawn—
Stranded—Weatherproof.





APPENDIX C—Page 25.

Sag Correction Factor—Supports at Different Elevations.



Sag Correction for Temperature—Copper—Soft Drawn.

**SAG CORRECTION FOR TEMPERATURE
SOFT DRAWN COPPER**

AVERAGE SAG CORRECTION FOR STRINGING TEMPERATURES OTHER THAN 60° F.

REQUIRED THE SAG AT SOME OTHER TEMPERATURE THAN 60° F.

ASSUMED FOR A GIVEN SPAN AND WIRE = S_t

THE SAG FOR A GIVEN SPAN AND WIRE AT 60° F. = S

DIFFERENCE IN TEMPERATURE BETWEEN STRINGING

TEMPERATURE AND 60° F. = T

FACTOR FOR INCREASE OR DECREASE IN SAG PER DEGREE

DIFFERENCE = d

THEN $S_t = S \pm dT$

EXAMPLE:—

SPAN = 225 FT., SAG AT 60° F. = 4.10 FT.

SAG = .0182, STRINGING TEMPERATURE = 90° F.

DIFFERENCE IN TEMPERATURE = 30° F.

CORRECTION PER DEGREE FOR THE RATIO SAG OF .0182

FOR TEMPERATURE ABOVE 60° F. IS .0174 FT. PER 1° F.

OR TOTAL CORRECTION IS $30 \times .0174 = .522$ FT.

CORRECTED SAG FOR 90° F. STRINGING TEMPERATURE IS

$4.10 + .522 = 4.622$ FT.

.070

.065

.060

.055

.050

.045

.040

.035

.030

.025

.020

.015

.010

.005

.000

.005

.010

.070

.065

.060

.055

.050

.045

.040

.035

.030

.025

.020

.015

.010

.005

.000

.005

.010

.070

.065

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.055

.050

.045

.040

.035

.030

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.015

.010

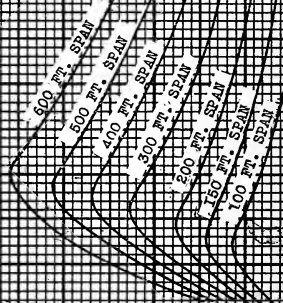
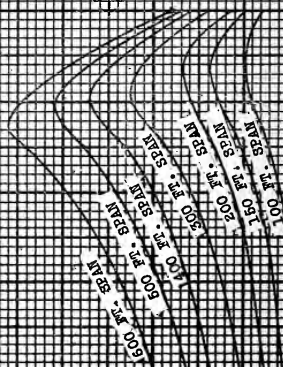
.005

.000

.005

.010

CORRECTION IN FEET PER 1° F. ABOVE OR BELOW 60° F.



THE ABOVE CURVES ARE FOR TEMPERATURES BELOW 60° F., AND THE CORRECTION IS TO BE SUBTRACTED FROM THE SAG AT 60° F.

VALUES OF SAG CORRECTION IS TO BE ADDED TO THE SAG AT 60° F.

THE ABOVE CURVES ARE FOR TEMPERATURES ABOVE 60° F., AND THE CORRECTION IS TO BE ADDED TO THE SAG AT 60° F.

Sag Correction for Temperature—Aluminum—Stranded.

AVERAGE SAG CORRECTION FOR STRINGING TEMPERATURES OTHER THAN 60° F.

REQUIRED THE SAG AT SOME OTHER TEMPERATURE THAN 60° F. FOR A GIVEN SPAN AND WIRE ST. AND WIRE AT 60° F. = S

ASSUMED THE SAG FOR A GIVEN SPAN AND WIRE AT 60° F. = S

DIFFERENCE IN TEMPERATURE BETWEEN STRINGING TEMPERATURE AND 60° F. = T

FACTOR FOR INCREASE OR DECREASE IN SAG PER DEGREE DIFFERENCE = d

St = 5 - 4 ft

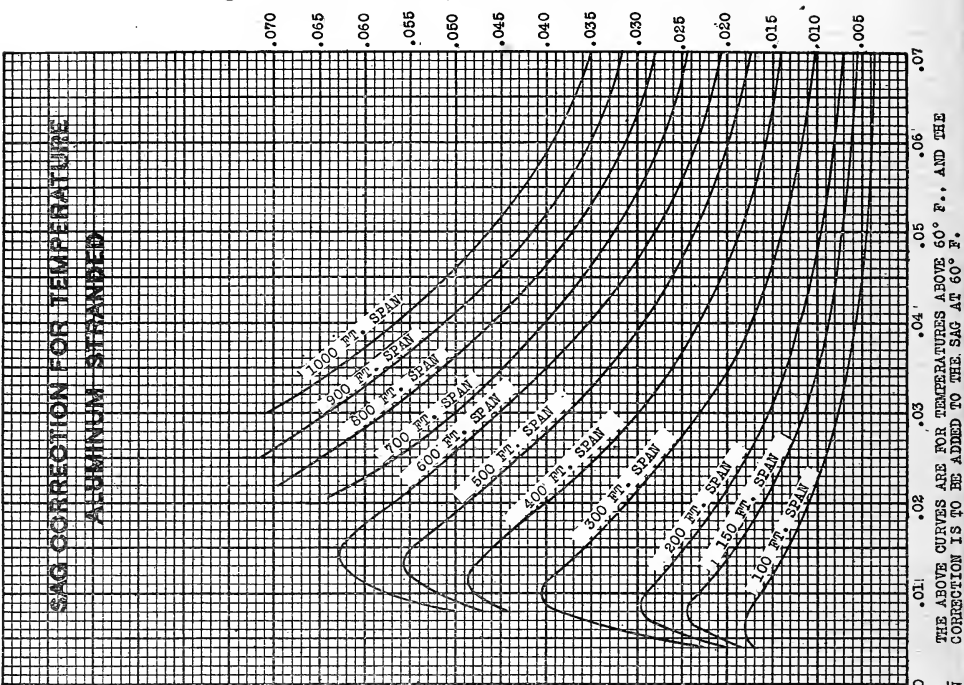
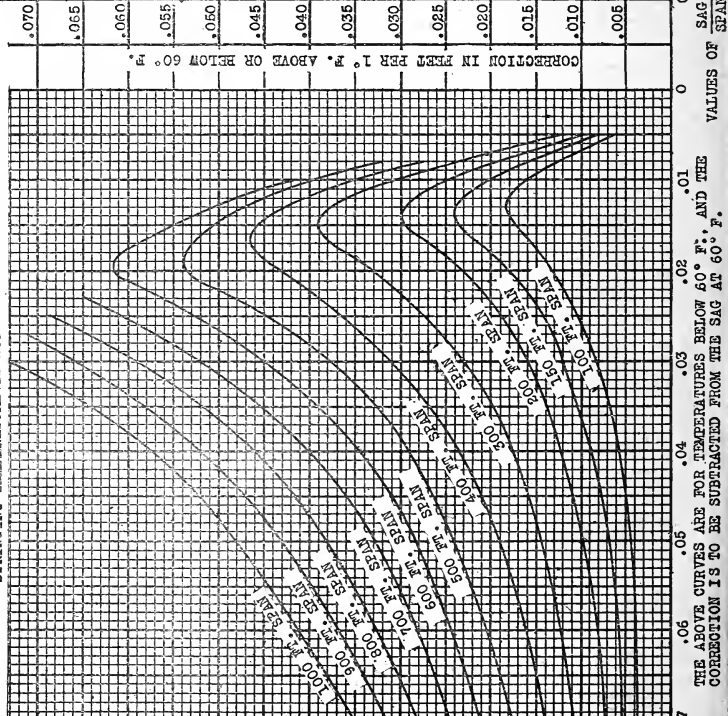
SPAN = 200 FT., SAG AT 60° F. = 2.3 FT. SAG = .0115,

STRINGING TEMPERATURE = 40° F. CORRECTION PER DEGREE DIFFERENCE IN TEMPERATURE = T = 20° F.

FOR THE RATIO SAG × SPAN FOR TEMPERATURES BELOW 60° F. IS .028 FT. PER 1° F., OR TOTAL CORRECTED SAG FOR 40° F. STRINGING TEMPERATURE IS 2.3 - .028 × 20 = 1.74 FT.

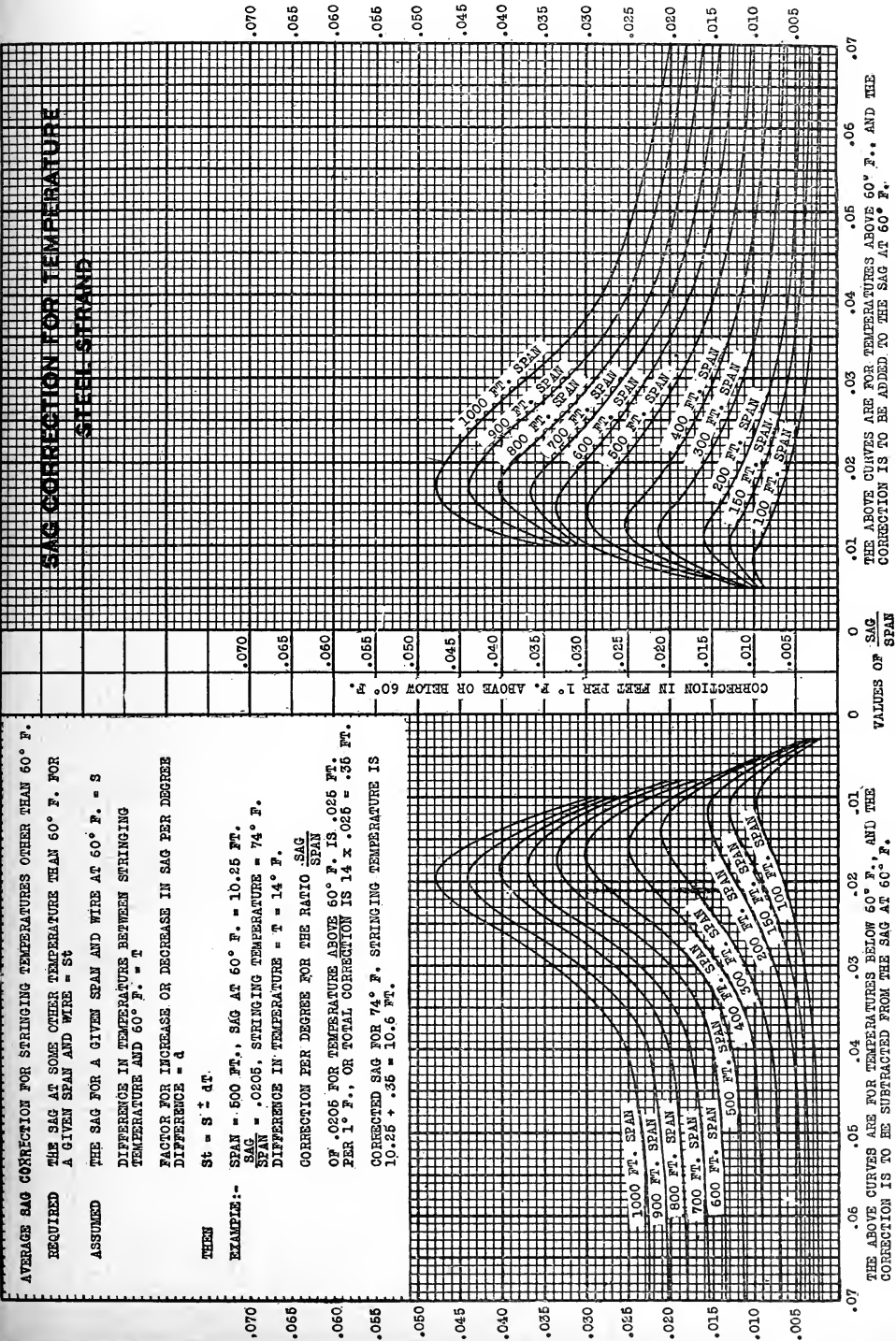
THEN

EXAMPLE:-

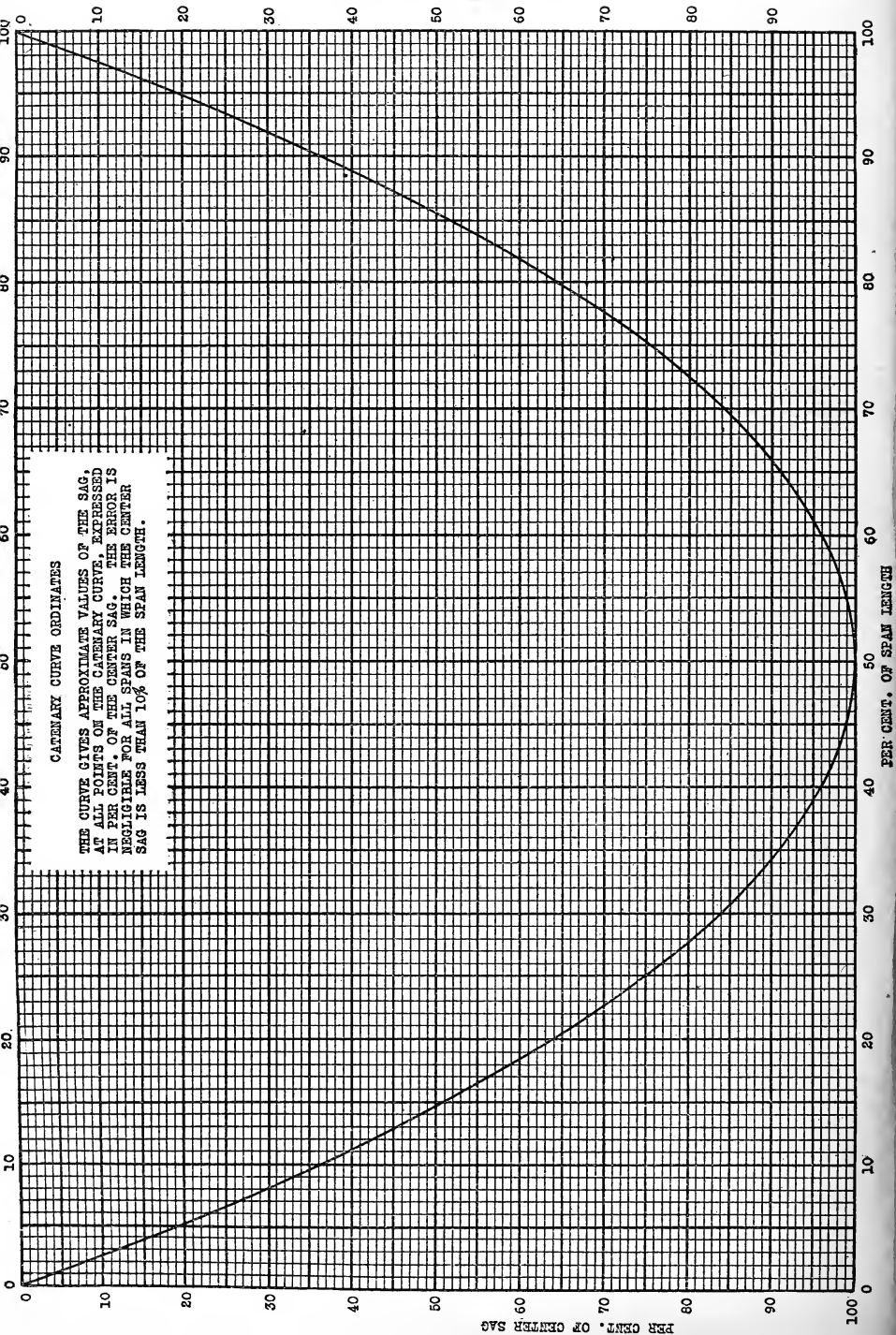


APPENDIX C—Page 29.

Sag Correction for Temperature—Steel Strand.



APPENDIX C—Page 30.
Catenary Curve Ordinates.



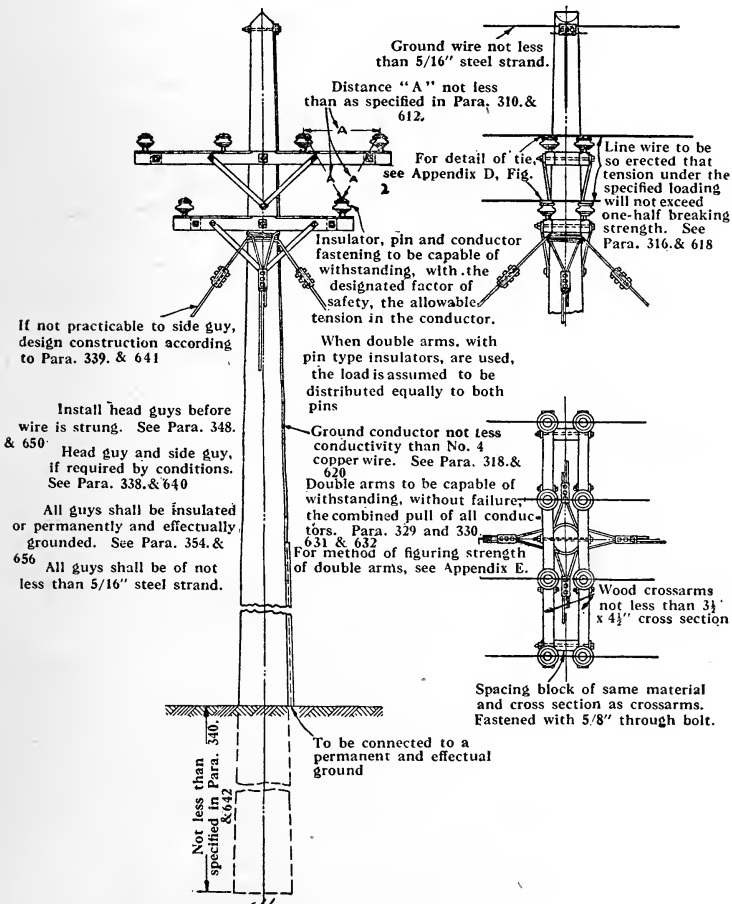
APPENDIX D.

Section III, Paragraphs 326 and 327.

Section VI, Paragraphs 628 and 629.

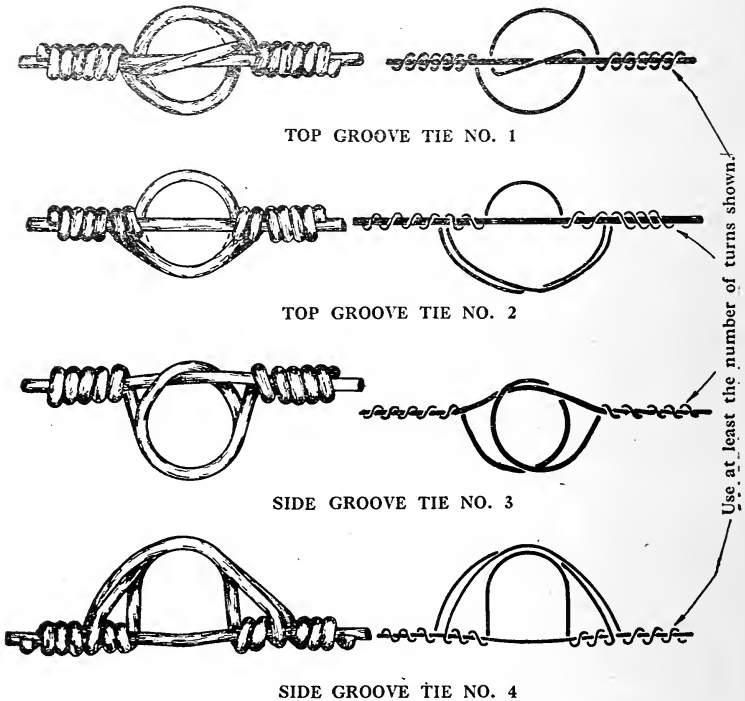
Section VII, Paragraph 712.

Fig. 1.—Suggested Method of Construction at Crossing Pole, Showing Conductor Attachments with Double Cross-arms, Pin Type Insulators and Ties.



APPENDIX D—Fig. 2.

Form of Ties for Power Lines.



All tie wires shall have a surface of the same metal as that of the line wire in order to prevent corrosion.

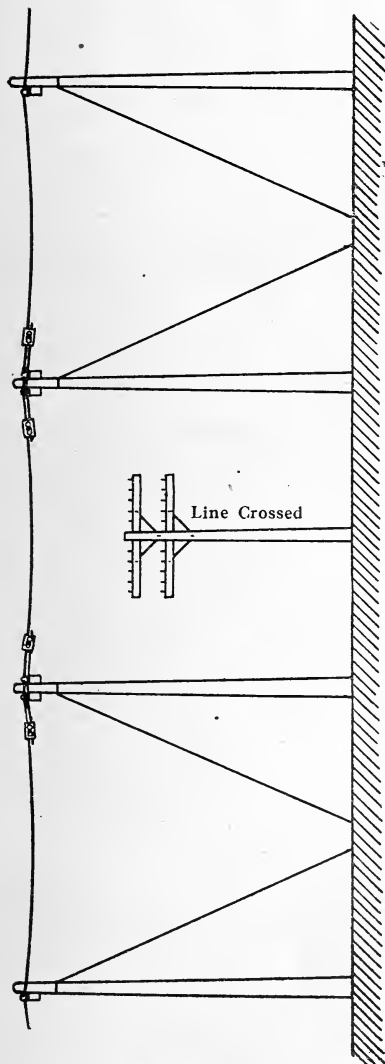
They shall be dead soft so that when twisted up they will hold tight and not tend to spring loose. No tie wire shall ever be replaced on a line after having been removed therefrom.

Use Following Size Wire for Making Ties

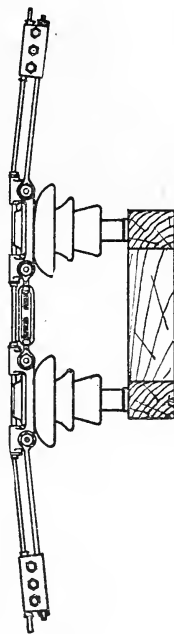
# 6 A. W. G. For # 6 A. W. G. Line Wire					
# 6	"	"	# 4	"	"
# 4	"	"	# 2	"	"
# 4	"	"	# 1	"	"
# 4	"	"	# 0	"	"
# 2,	"	"	# 00	"	and Larger.

APPENDIX D—Fig 3.

Use of Clamps with Double Pin Type Insulator.

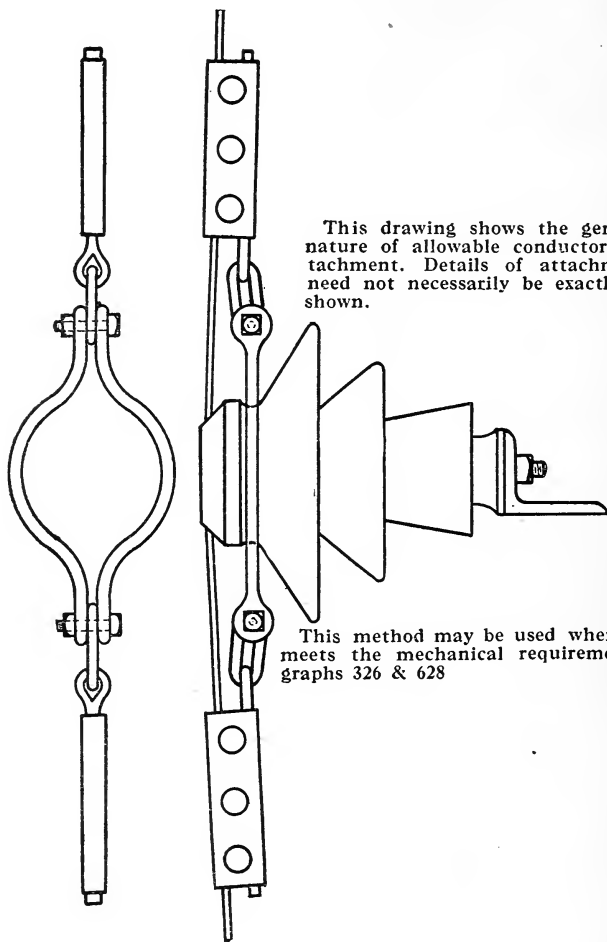


This drawing shows the general nature, of allowable conductor attachment. Details of attachment need not necessarily be exactly as shown.



APPENDIX D—Fig. 4.

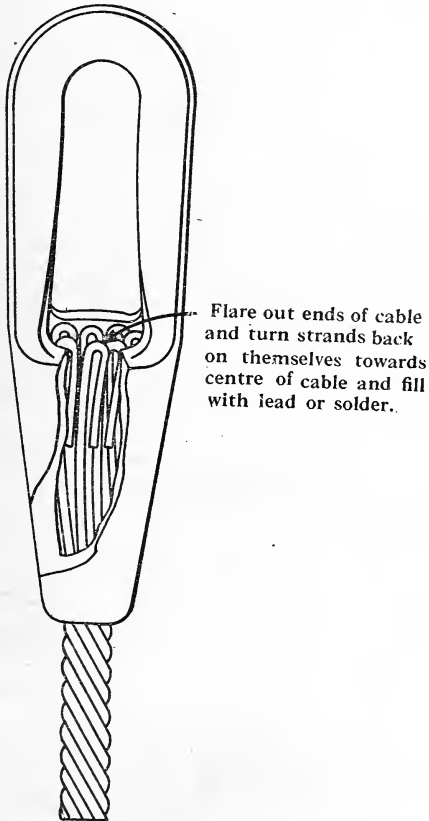
Use of Clamp with Single Pin Type Insulator and Metal Crossarm.



APPENDIX D—Fig. 5.

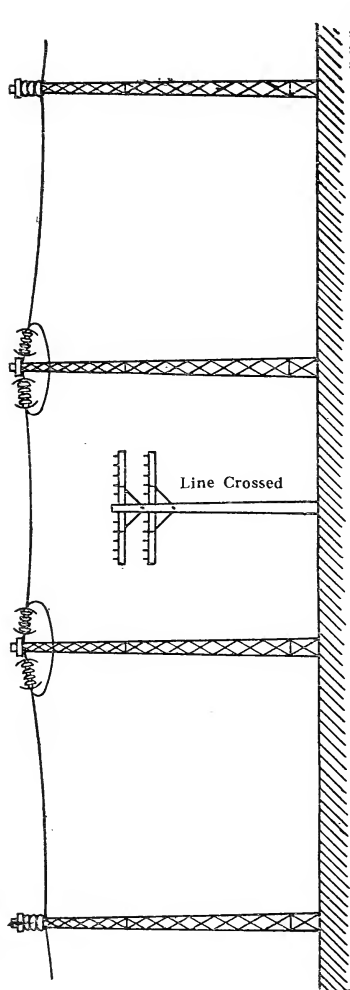
Rope Socket for Attaching Large Size Conductor to Dead End Insulator.

This drawing shows the general nature of allowable conductor attachment. Details of attachment need not necessarily be exactly as shown.



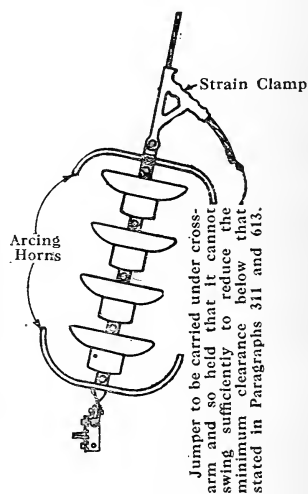
APPENDIX D—Fig. 6.

Disc Type Insulators. Dead End Construction.



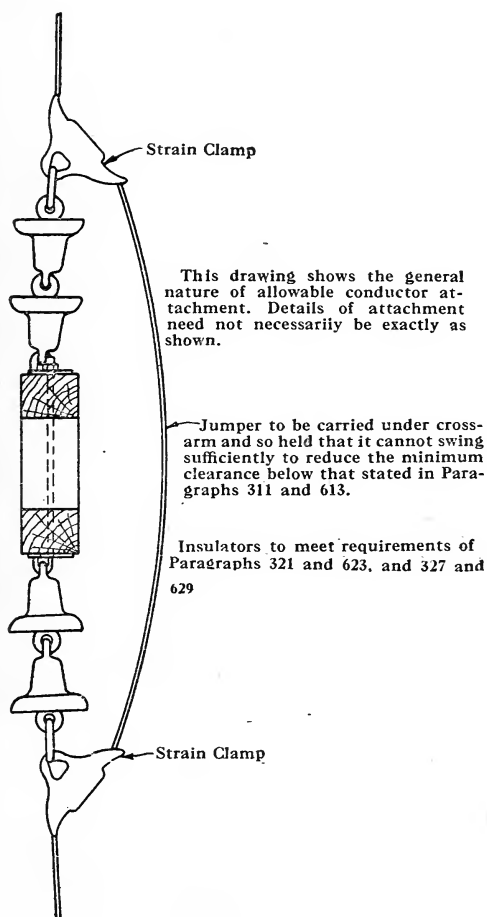
This drawing shows the general nature of allowable conductor attachment. Details of attachment need not necessarily be exactly as shown.

Insulators to meet requirements of Paragraphs 321 and 623 Arcing Horns may be omitted if requirements of Paragraphs 327 and 629 also are complied with, or if insulator support is not grounded.



APPENDIX D—Fig. 7.

Use of Disc Type Insulators. Dead End Construction on Wood Crossarms.

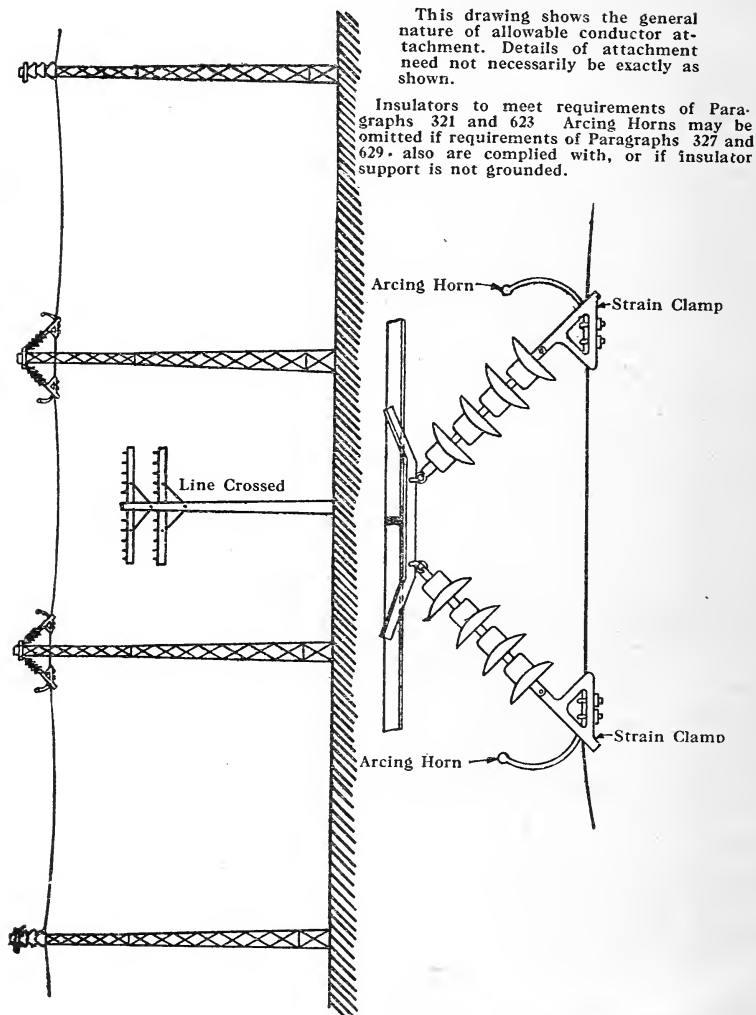


Sec. IX.

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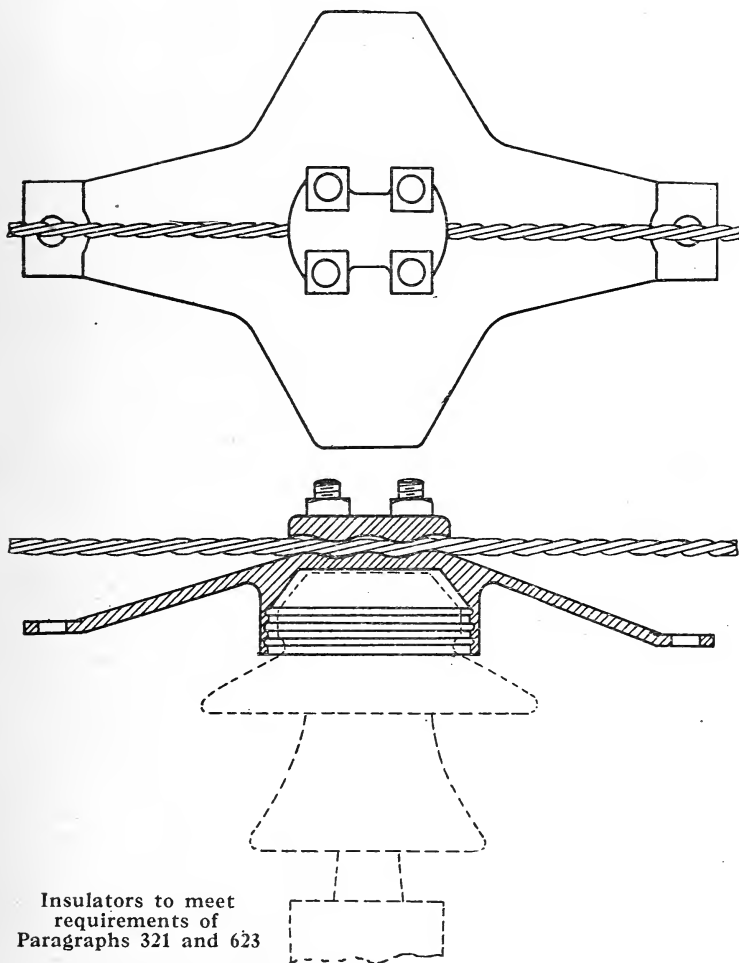
APPENDIX D—Fig. 8.

Disc Type Insulators. Double String.



APPENDIX D—Fig. 9.

Arcing Shield on Pin Type Insulator.



Insulators to meet
requirements of
Paragraphs 321 and 623

This drawing shows the general nature of allowable conductor attachment. Details of attachment need not necessarily be exactly as shown.

APPENDIX E.

METHOD OF FIGURING STRENGTH OF DOUBLE CROSSARMS.

When double crossarms are connected together at the ends with spacing blocks, bolts or plates, their combined strength in the direction of the pull of the conductors is in excess of double the strength of a single crossarm and is less than the strength of two crossarms of similar dimensions and spacing, connected as a rigid truss.

Allowance is made for this in the following manner:

- (a) Double wood or steel crossarms, attached to poles, connected together at the ends by bolts with spacing nuts and washers or by bolts with pipe spacers or similar construction, will be considered as having a strength not in excess of thirty (30) per cent. of the strength of two crossarms, of similar dimensions and spacing, connected as a rigid truss.
- (b) Double wood or steel crossarms, attached to poles, connected together at the ends by spacing blocks or plates, bolted or riveted to the crossarms will be considered as having a strength not in excess of forty (40) per cent. of the strength of two crossarms, of similar dimensions and spacing, connected as a rigid truss.
- (c) Steel crossarms designed to take shear between the main members will be allowed a factor of strength in accordance with their construction.

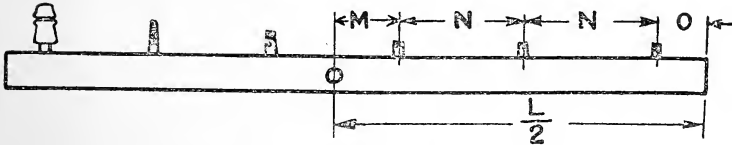
PROBLEM.

Using double standard three and one-half ($3\frac{1}{2}$) inch x four and one-half ($4\frac{1}{2}$) inch 6-pin cross-arms spaced six (6) inches apart, the separation being maintained by spreader blocks and bolts, will the requirements of Paragraphs 330 (b) and 632 (b) be obtained in arms of Yellow Pine or Washington Fir, if each of the conductors is stressed in the same direction with an unbalanced pull of 2,000 pounds?

APPENDIX E—Page 2.

SOLUTION.

N. E. L. A. STANDARD 6-PIN CROSSARM.



$$m = 15 \text{ in.}$$

$$n = 14.5 \text{ in.}$$

$$o = 4 \text{ in.}$$

$$\frac{L}{2} = 48 \text{ in.}$$

Full—2,000 pounds on each pin.

In determining the total bending moment, it is necessary to consider the total load applied to one side only.

The total bending moment is the sum of

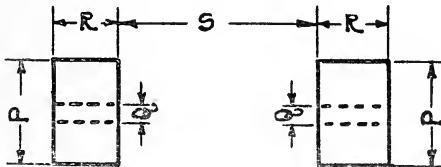
$$2,000 \times m = 2,000 \times 15 = 30,000 \text{ pound-inches.}$$

$$2,000 \times m+n = 2,000 \times 29.5 = 59,000 \text{ pound-inches.}$$

$$2,000 \times m+n+n = 2,000 \times 44 = 88,000 \text{ pound-inches.}$$

That is, Total Bending Moment, ... = 177,000 pound-inches.

SECTION OF DOUBLE CROSSARMS.



For N. E. L. A. standard 6-pin crossarms,

$$p = 4\frac{1}{2} \text{ in.}$$

$$q \text{ (diam. of bolt hole)} = 11/16 \text{ in.}$$

$$r = 3\frac{1}{2} \text{ in.}$$

$$s \text{ (spacing between arms)} = 6 \text{ in.}$$

Sec. IX.

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APPENDIX E—Page 3.

$$\text{Moment of Inertia} = \frac{bd^3}{12}$$

$$b = p - q = 3 \frac{13}{16} \text{ in.} = 3.81 \text{ in.}$$

$$d^3 = (r+r+s)^3 - s^3 = (13^3 - 6^3) = 1981.$$

$$\frac{bd^3}{12} = \frac{3.81 \times 1981}{12} = 628.97 = \text{Moment of Inertia}$$

$$\text{Section Modulus of rigid truss} =$$

$$\frac{\text{Moment of Inertia}}{\frac{1}{2}(r+r+s)} = \frac{628.97}{6.5} = 96.76$$

$$\text{Allowable Section Modulus (See (b) above)} = 40 \text{ per cent. of Section Modulus of rigid truss.}$$

$$96.76 \times .4 = 38.704.$$

$$\text{Fibre Stress} =$$

$$\frac{\text{Bending Moment}}{\text{Section Modulus}} = \frac{177,000}{38.704} = 4573 \text{ lbs. per sq. in.}$$

which is well within the ultimate fibre stress of either Yellow Pine or Washington Fir (as obtained by multiplying the Allowable Working Unit Stress, Appendix F, by the Factor of Safety, Paragraph 359 or 661).

APPENDIX F.

ALLOWABLE WORKING UNIT STRESSES.

Obtained by dividing approved ultimate unit strengths by the factors of safety given in Paragraphs 359 and 661.

Structural Steel:

	Pounds Per Square Inch
Tension (net section),	18,000
Shear,	14,000
Compression,	18,000—60 $\frac{L}{R}$

NOTE:—The following allowable working unit stresses for structural steel may be used in figuring steel towers to meet the requirements of Paragraph 338—(b) Section III, or Paragraph 640—(b) Section VI.

Tension (net section)	24,000
Shear	18,700
Compression	24,000—60 $\frac{L}{R}$

Bolts, Rivets, Pins:

Shear,	12,000
Bearing,	24,000
Bending,	18,000

Conductor:

Copper, hard-drawn, solid—

A. W. G. 4/0, 3/0, 2/0,	25,000
A. W. G. 1/0,	27,500
A. W. G. No. 1,	28,500
A. W. G. No. 2, 4, 6,	30,000
Copper, soft-drawn, solid,	17,000
“ hard-drawn, stranded,	30,000
“ soft-drawn, stranded,	17,000
Aluminum, hard-drawn, stranded,	11,500

APPENDIX F—Page 2.

Timber:	Working Values for Bending Lbs. per Sq. In.
Eastern White Cedar,	900
Chestnut,	1,275
Washington Cedar,	1,275
Idaho Cedar,	1,275
Port Orford Cedar,	1,725
Long Leaf Yellow Pine,	1,500
Short Leaf Yellow Pine,	1,200
Douglas Fir,	1,350
White Oak,	1,425
Red Cedar,	1,050
Bald Cypress (Heartwood),	1,200
Redwood,	975
Catalpa,	750
Juniper,	825

Values based upon factor of safety of four (4); compression working values equal bending working values multiplied by $(1 - \frac{L}{60D})$;

L—Length in inches.

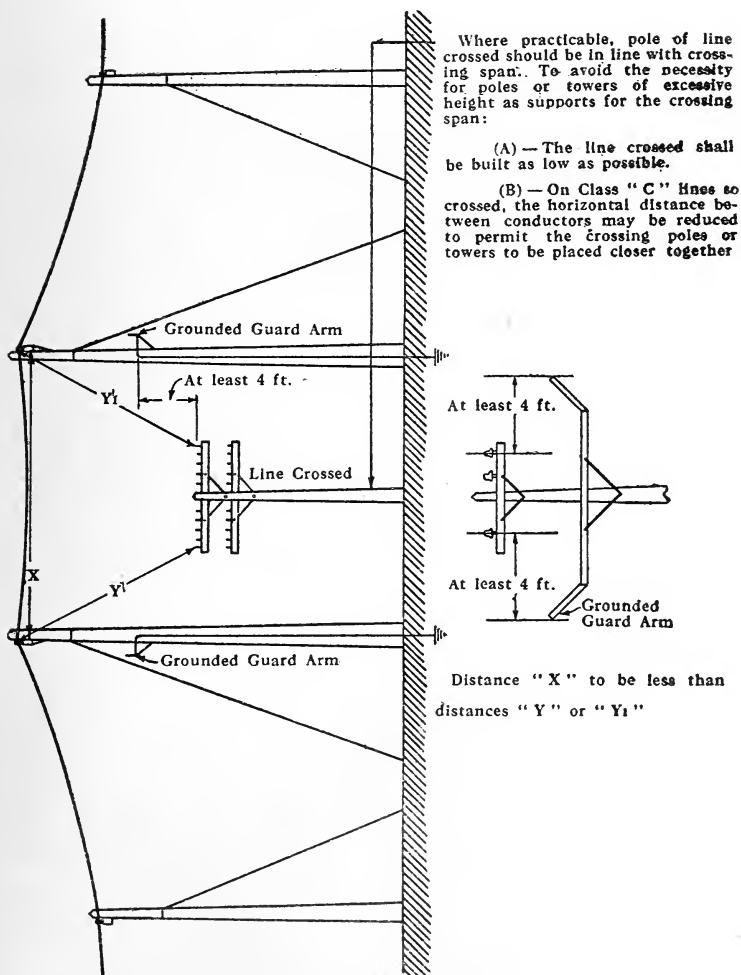
D—Length side, or diameter, in inches.

APPENDIX G.

Section III, Paragraph 362.

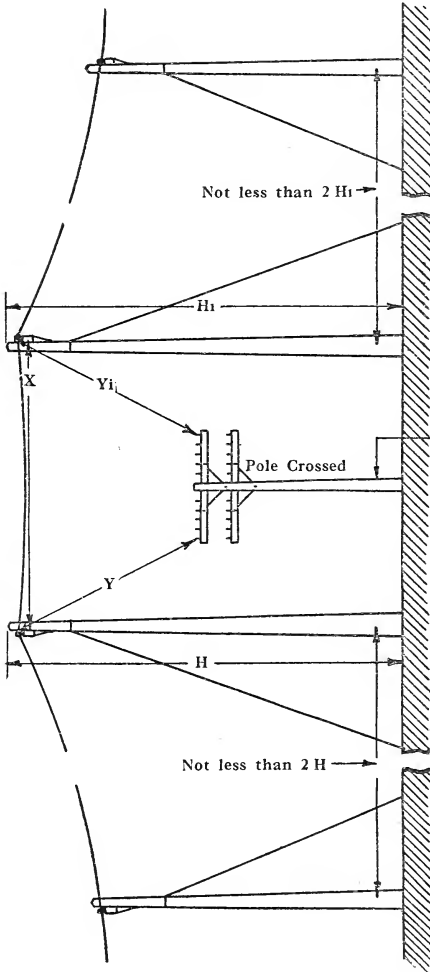
Section VI, Paragraph 664.

Fig. 1.—Short Span Construction.



APPENDIX G—Fig. 2.

Short Span Construction.



Conductors in the crossing span and the next adjoining spans shall meet the requirements of Paragraphs 313-317 and 615-619 Inclusive.

Where practicable, pole of line crossed should be in line with crossing span. To avoid the necessity for poles or towers of excessive height as supports for the crossing span:

(A) — The line crossed shall be built as low as possible.

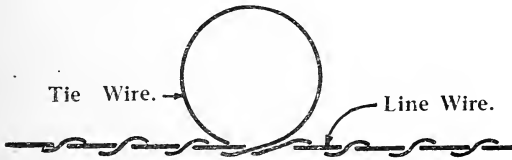
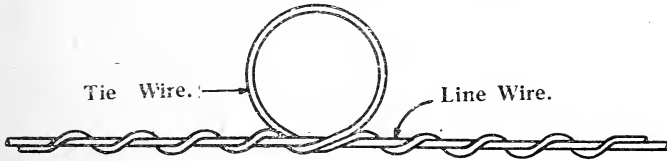
(B) — On Class "C" lines so crossed, the horizontal distance between conductors may be reduced to permit the crossing poles or towers to be placed closer together.

Distance "X" to be less than distances "Y" or " Y_1 "

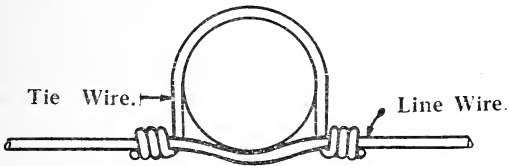
APPENDIX H.

Section V, Paragraph 542.

Method of Tying Wire to Insulators.



Tie For Copper Wire.



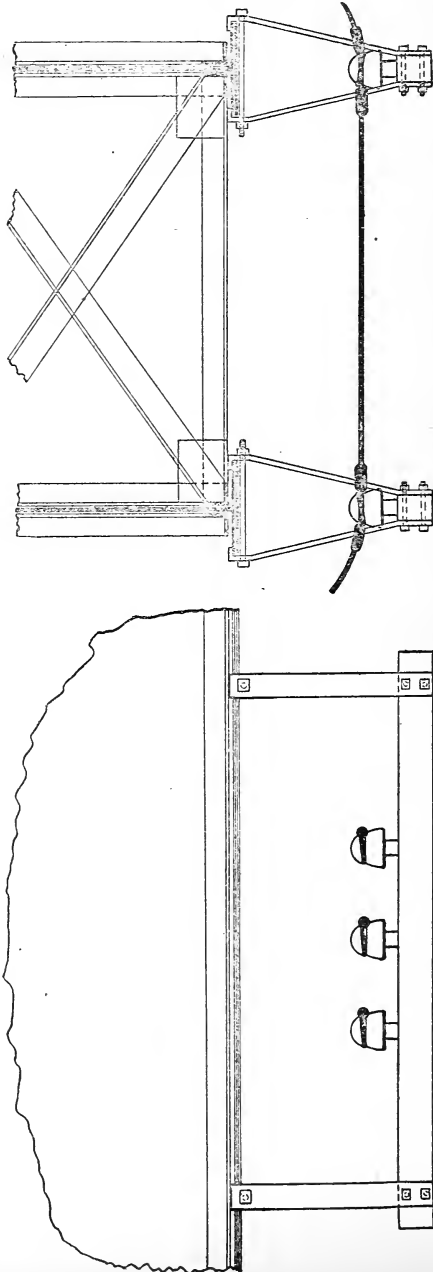
Tie For Iron Wire.

For size of tie wires see Paragraph 542.

APPENDIX I.

Section VII, Paragraph 714.

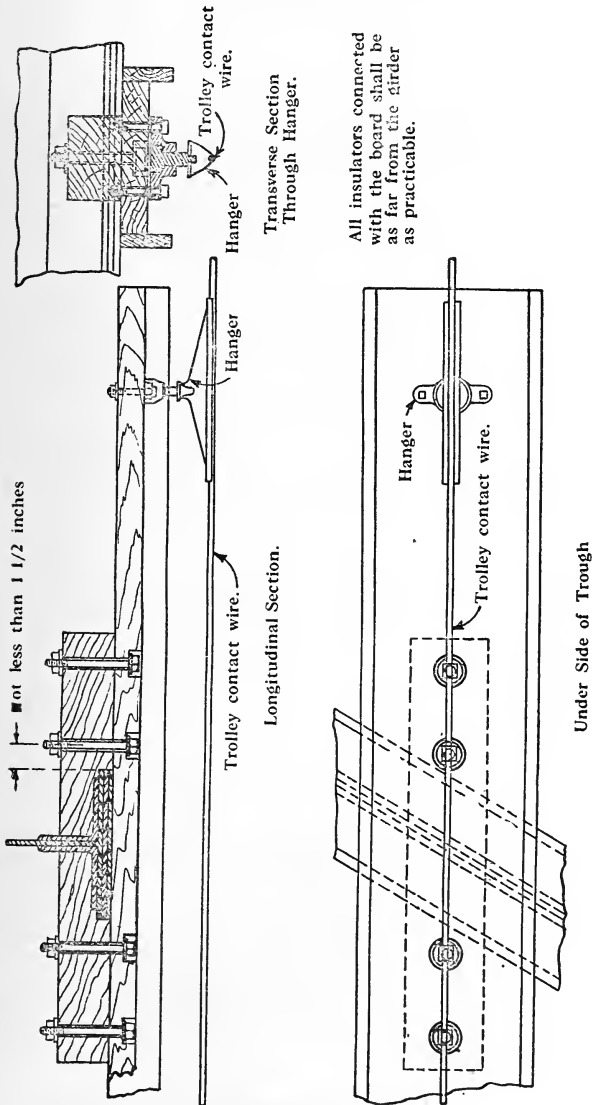
Fig. 1.—Suggested Method of Attaching Conductor in open Construction Steel Bridges.



APPENDIX I—Fig. 2.

Section VII, Paragraph 716.

Suggested Design of Wooden Inverted Trough for Protection where
Trolley Contact Wires are Attached to Steel Bridges.



APPENDIX J.

TYPICAL CROSSING OF POWER LINE OVER
RAILROAD.

WITH WOODEN POLE CONSTRUCTION IN WHICH CROSSING
POLES CANNOT BE SIDE GUYED.

DATA OF CROSSING.

Voltage of Circuit.—22,000 Volts.

Lightning Protection Wire.—One (1) five-sixteenths ($5/16$) inch Galvanized Steel Strand, ultimate strength 4,860 pounds.

Conductors.—Twelve (12) No. 2 A. W. Gauge Soft Drawn Copper—Solid—Bare.

Insulators.—Porcelain, to meet requirements of Paragraphs 623 and 629.

Pins.—Steel, with five-eighths ($5/8$) inch bolt.

Ties.—No. 4 A. W. Gauge—Top Groove No. 1 or No. 2—Appendix D, Figure 2.

Crossarms.—Three and one-half ($3\frac{1}{2}$) inches by four and one-half ($4\frac{1}{2}$) inches Yellow Pine—eleven-sixteenths ($11/16$) inch pin holes—eleven-sixteenths ($11/16$) inch hole for through pole bolt.

Poles.—Chestnut—Class "A."

Pole Framing.—Lightning protection wire attached six (6) inches from top of pole. Center of top crossarm five (5) feet below point of attachment of lightning protection wire. Center of second crossarm two and one-half ($2\frac{1}{2}$) feet below center of top crossarm. Center of third crossarm two and one-half ($2\frac{1}{2}$) feet below center of second crossarm.

Location of Poles.—The location of poles in reference to railroad tracks, and in reference to the associated paralleling pole line of the railroad, is as shown in the plan given on Page 153.

Railroad Pole Line.—Height of top wire on the associated paralleling pole line of the railroad company, above elevation of top of rail at point of crossing, twenty-four (24) feet.

APPENDIX J—Page 2.

Length of Crossing Span.—150 Feet.

Length of Adjacent Span.—120 Feet.

Level of ground at base of pole assumed to be at same elevation as top of rail.

CONSTRUCTION REQUIREMENTS DETERMINED AS
FOLLOWS:

Sag of Conductors (Under Normal Conditions).

The sag in the crossing span will be determined from curve for soft drawn, bare, solid copper wire given on Page 92.

For No. 2 A. W. Gauge, span 150 feet—sag = two and seven-tenths (2.7) feet.

In adjacent spans, for balanced condition of stress, under normal conditions, the sags will be inversely proportional to the square of the length of the spans. In the spans adjacent to the crossing span, the normal sag, therefore, will be

$$2.7 \text{ feet} \times \frac{(120)^2}{(150)^2} = 1.73 \text{ feet}$$

Sag of Lightning Protection Wire.

From sag curves of steel strand given on Page 101, the normal sag for five-sixteenths (5/16) inch Siemens-Martin strand, span 150 feet, is less than six (6) inches. Therefore, the same sag as for the conductors, or two and seven-tenths (2.7) feet in crossing span, and one and seventy-three one-hundredths (1.73) feet in adjacent spans, can be used with increased factor of safety.

Spacing Conductors—From Page 158.

Volts	Span	Sag	Required Spacing
22,000	100 Feet	2 Feet	2 Feet 6 Inches
22,000	200 Feet	4 Feet	2 Feet 6 Inches

Therefore, for span of 150 feet, sag two and seven-tenths (2.7) feet, the same spacing would be required, or two (2) feet six (6) inches. As the conductors on adjacent crossarms are supported in the same vertical plane, the gain spacing for crossarms will also be two (2) feet, six (6) inches.

APPENDIX J—Page 3.

Clearances of Conductors Over Crossarms.

The vertical clearance of the conductor above the crossarm, obtained from Page 157, for 22,000 volts, is six and seventy-five one-hundredths (6.75) inches. This makes the vertical distance between the conductor and the centre of the crossarm nine (9) inches.

Vertical Clearances of Conductors Over Railroad Pole Lines.

The pole has a height of fifty (50) feet, and is set seven (7) feet in the ground. From the dimensions of the pole framing given in the "Data of Crossing" above, the distance from the centre of the lowest crossarm to the ground will be thirty-two and fifty one-hundredths (32.50) feet. The distance of the conductors above the crossarms is nine (9) inches. Therefore, the conductors on the lowest crossarm are thirty-three and twenty-five one-hundredths (33.25) feet above the ground level. The ground level is given as at the same elevation as the top of the rail.

The sag of the conductors in the crossing span is determined above as two and seven-tenths (2.7) feet. From the plan given on Page 153, the distance "D" referred to on Page 155, is seventy-five (75) feet. Therefore, from this table the minimum vertical clearance required over the top wire of the railroad pole line at the point of crossing is six (6) feet. This point of crossing is, from the plan, fifty-four (54) feet from the nearest crossing pole, "B," or thirty-six (36) per cent. of the crossing span length. The sag at thirty-six (36) per cent. of the span length is, from the curve, Page 116, ninety-two (92) per cent. of the centre sag. The centre sag is two and seven-tenths (2.7) feet making the sag at point of crossing over railroad pole line ninety-two (92) per cent. of two and seven-tenths (2.7) feet, or two and forty-eight one-hundredths (2.48) feet. Therefore, the clearance of lowest conductor over elevation of top of rail at point of crossing with the railroad pole line will be thirty-three and twenty-five one-hundredths (33.25) feet, less two and forty-eight one-hundredths (2.48) feet, or thirty and seventy-seven one-hundredths (30.77) feet. As the top wire of railroad

APPENDIX J—Page 4.

pole line at this point is given as twenty-four (24) feet above top of rail, the clearance at this point between the lowest power wire and the top wire of the railroad pole line will be six and seventy-seven one-hundredths (6.77) feet, which is in excess of the minimum required clearance of six (6) feet determined above.

Clearance of Lowest Power Line Over Railroad Track.

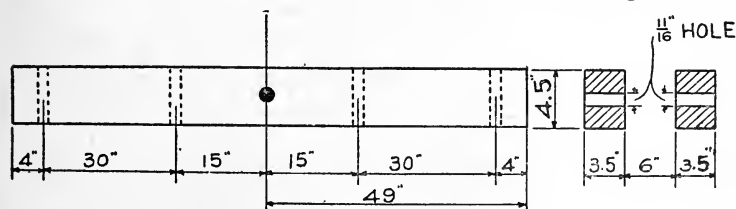
The centre sag of the crossing span, determined as above, is two and seven-tenths (2.7) feet. Therefore, the clearance over the top of the rails will be the height of the lowest conductor above the top of the rail at its point of attachment on the pole, less this sag, or thirty-three and twenty-five one-hundredths (33.25) feet, less two and seven-tenths (2.7) feet, equal to thirty and fifty-five one-hundredths (30.55) feet, which is greater than the vertical clearance required at this point from Page 156, the minimum required clearance being twenty-eight (28) feet, six (6) inches.

Conductor Attachments.

As the conductors in the crossing span are strung with a normal sag of two and seven-tenths (2.7) feet, the stress in each conductor, under the conditions of maximum loading (zero (0) degrees Fahrenheit, one-half ($\frac{1}{2}$) inch ice and eight (8) pounds wind) will be equal to one-half ($\frac{1}{2}$) the ultimate strength of the conductor, or, from Page 160, 890 pounds. As this is less than 2,000 pounds, the conductors may be attached to double pin type insulators, with ties as specified in Paragraphs 326 and 628, and as shown in Appendix D, Figure 1.

Crossarms.

Crossarms to be of Long Leaf Yellow Pine, of dimensions as shown in sketch below, and to be double, with spacing blocks:



APPENDIX J—Page 5.

Dead Load on Crossarms (Paragraph 632 (a)).

The vertical load on the two (2) crossarms, under maximum conditions of loading, will be, for each conductor, equal to the weight per foot of ice covered wire, times one-half ($\frac{1}{2}$) the sum of the length of the crossing and adjacent span, or .673 lbs. (from Page 160) $\times 150 + 120 = 91$ lbs.

2

The weight per arm per conductor = 45.5 lbs.

Bending Moment per arm

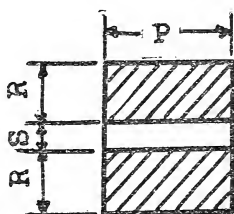
$$45.5 \times 15 = 683 \text{ pound-inches.}$$

$$45.5 \times 45 = 2,048 \text{ pound-inches.}$$

Total Bending Moment, 2,731 pound-inches.

The point of maximum bending moment will be at the through bolt attaching the arm to the pole, at which point the cross section of the arm is reduced by the amount of the bolt hole.

The following shows the method of figuring the moment of inertia of one crossarm at this point:



$$P = 3.5$$

$$R = 1.90625$$

$$S = .6875$$

$$\text{Moment of Inertia} = \frac{bd^3}{12}$$

$$b = P = 3.5$$

$$d^3 = (R+R+S)^3 - S^3 = 90.8$$

$$\frac{bd^3}{12} = 26.5 \text{ Moment of Inertia}$$

$$\begin{aligned} \text{Section Modulus} &= \frac{\text{Moment of Inertia}}{\frac{1}{2} (R+R+S)} \\ &= \frac{26.5}{2.25} = 11.8 \end{aligned}$$

APPENDIX J—Page 6.

$$\text{Fibre Stress} = \frac{\text{Bending Moment}}{\text{Section Modulus}} = \frac{2731}{11.8} = 231 \text{ lbs.}$$

As the allowable fibre stress, from Appendix F, is 1,500 pounds, the stress due to the dead load is well within the limit.

In the above calculation, no account has been taken of weight of pins and insulators, and of ice on the crossarm, and no allowance made for additional strength afforded by crossarm braces.

Unbalanced or Broken Wire Load on Crossarms (Paragraphs 632 (b).

“To withstand, at all times without failure, the unbalanced stress due to the combined pull in one direction of all the conductors supported,—the pull of each conductor being taken as the tension in the conductor due to the specified load.”

The pull of each conductor due to the specified loading, as the assumed sag, is equal to one-half ($\frac{1}{2}$) the ultimate strength of the conductor, or, from Page 160, for No. 2 A. W. Gauge, soft drawn, bare, solid copper wire, 890 pounds.

The fibre stress for double arms fitted with spacing blocks for the unbalanced load due to the pull of the four (4) conductors supported, will be determined, as set forth in Appendix E, as follows:

Using the notation given in the sketch in that Appendix:

$$m = 15 \text{ inches}$$

$$n = 30 \text{ inches}$$

$$o = 4 \text{ inches}$$

$$\frac{L}{2} = 49 \text{ inches}$$

$$\text{Pull} = 890 \text{ pounds per conductor.}$$

Bending Moment

$$890 \times 15 = 13,500 \text{ pound-inches.}$$

$$890 \times 45 = 40,050 \text{ pound-inches.}$$

$$\text{Total Bending Moment } 53,550 \text{ pound-inches.}$$

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$p = 4.5$ inches.

q (diam. of bolt hole) $= 11/16$ inch.

$r = 3.5$ inches.

$s = 6.0$ “

Moment of Inertia $= \frac{bd^3}{12}$

$b = p - q = 3 \frac{13}{16}$ inches $= 3.81$ inches.

$d^3 = (r + r + s)^3 - s^3 = (13^3 - 6^3) = 1981$.

$\frac{bd^3}{12} = \frac{3.81 \times 1981}{12} = 628.97$ Moment of Inertia.

Section Modulus of rigid truss $=$

Moment of Inertia $\frac{628.97}{\frac{1}{2}(r + r + s)} = \frac{628.97}{6.5} = 96.76$.

Allowable Section Modulus $= 40\%$ of Section Modulus of rigid truss $= 96.76 \times .4 = 38.704$.

Fibre Stress $=$

Bending Moment $\frac{53,550}{\text{Section Modulus } 38.704} = 1,383$ lbs.

Under the unbalanced stress due to the combined pull in one direction of all conductors supported, the double arms can be stressed to their ultimate strength. This ultimate strength is, for Long Leaf Yellow Pine, 6,000 pounds, and the calculated fibre stress is well within this limit. .

Poles.

The crossing poles are given as Class “A” Chestnut. Dimensions are as follows:

Length	50	feet
Height above ground.....	43	feet
Circumference at top.....	24	inches
Diameter at top.....	7.63	inches
Circumference 6 feet from butt....	51	inches
Circumference at ground.....	50.4	inches
Diameter at ground.....	16	inches

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Distance from ground line to conductors supported is given as follows:

Lightning protection wire.....	42.50 feet
Conductors on top arm.....	38.25 feet
“ “ second arm.....	35.75 feet
“ “ lowest arm.....	33.25 feet

Ground level at base of pole is stated to be at the same elevation as top of rail.

Transverse Load on Poles “B” and “C.”

Due to wind on ice covered poles and wires. Assume maximum stress to be at the ground line.

The approximate moment at the ground, due to wind pressure on the pole would be

$$M_p = \frac{PH^2 (D_1 + 2D_2)}{72} \text{ pound-feet.}$$

P = Pressure in pounds per square foot on projected area of ice covered pole.

H = Height of pole above ground, in feet.

D_1 = Diameter of pole at ground, in inches.

D_2 = Diameter of pole at top, in inches.

The moment at the ground, due to wind pressure on the wires, would be

$$M_c = L n P_h \frac{(S_1 + S_2)}{2} \text{ pound-feet.}$$

P_h = Horizontal load per lineal foot for 8.0 pounds wind and $\frac{1}{2}$ inch ice. Values for P_h for various sizes of wire are given on Pages 160 to 165, inclusive.

L = Height of wires above ground, in feet.

n = Number of wires.

S_1 and S_2 = Length of adjacent spans, in feet.

M_p = Moment due to wind pressure on pole.

M_{co} = Moment due to wind pressure on lightning protection wire.

M_{c1} = Moment due to wind pressure on wires on top arm.

M_{c2} = Moment due to wind pressure on wires on second arm.

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M_{c_3} = Moment due to wind pressure on wires on third arm.

Total Moment = $M_p + M_{c_0} + M_{c_1} + M_{c_2} + M_{c_3}$.

Moment due to wind pressure on pole with $\frac{1}{2}$ inch ice covered surface.

$$D_1 + \frac{1}{2} \text{ inch ice} = 17.00$$

$$D_2 + \frac{1}{2} \text{ inch ice} = 8.63$$

$$M_p = \frac{8 (43)^2 \times (17 + 2 (8.63))}{72} = 7,039 \text{ lb.-ft.}$$

Moment due to lightning protection wire

$$P_h = .875 \text{ for } 5/16 \text{ inch galvanized strand—Page 161.}$$

$$M_{c_0} = 42.5 \times 1 \times .875 \times \frac{(120 + 150)}{2} = 5,020 \text{ lb.-ft.}$$

Moment due to wires on cross-arms

$$P_h = .839 \text{ for No. 2 A. W. Gauge, solid, bare wire.}$$

$$M_{c_1} = 38.25 \times 4 \times .839 \frac{(120 + 150)}{2} = 17,330 \text{ lb.-ft.}$$

$$M_{c_2} = 35.75 \times 4 \times .839 \frac{(120 + 150)}{2} = 16,197 \text{ lb.-ft.}$$

$$M_{c_3} = 33.25 \times 4 \times .839 \frac{(120 + 150)}{2} = 15,064 \text{ lb.-ft.}$$

$$\text{Total Bending Moment} = 60,650 \text{ lb.-ft.}$$

$$\text{Moment of Resistance} = M = \frac{F \pi D_1^3}{384} = \frac{F D_1^3}{122}$$

In which M = Moment in pound-feet.

F = Fibre stress in pounds per square inch.

D_1 = Diameter of pole at ground.

$$F \frac{16^3}{122} = 60,650 \text{ pounds}$$

$$F = 1,807 \text{ " " = fibre stress per square inch.}$$

The allowable fibre stress for chestnut poles, from Appendix F, is 1,275 pounds. Therefore, to meet the requirements of

APPENDIX J—Page 10.

Paragraph 640 (a), the Poles "B" and "C" should be side guyed, but it is assumed that it is physically impossible to side guy these poles, and that the nearest poles that can be side guyed are "A" and "E." The guyed poles "A" and "E," and the entire line between them, must, therefore, be built in accordance with the requirements of Paragraph 641. Poles "B," "C" and "D" carry thirteen (13) wires, and must be able to withstand the transverse load of the wind on the ice covered poles and wires, with a factor of safety of two (2). A factor of safety of two (2) will permit a fibre stress of 2,550 pounds.

The figured fibre stress of these poles, due to the transverse load, as calculated above, is 1,807 pounds, and is, therefore, well within the requirements of Paragraph 641.

Unbalanced Load on Crossing Poles "B" and "C."

(Paragraph 640, (b).)

"To withstand, at all times without failure, the unbalanced stress due to the combined pull in the direction of the crossing of all the conductors supported,—the pull of each conductor being taken as the tension in the conductor due to the specified load."

Pull of ground wire, one-half ($\frac{1}{2}$) ultimate strength=2,340 lbs.

Pull of each conductor, one-half ($\frac{1}{2}$) ultimate strength=890 lbs.

Bending Moments

$$2,430 \times 42.50 = 103,275 \text{ pound-feet.}$$

$$3,560 \times 38.25 = 136,170 \text{ pound-feet.}$$

$$3,560 \times 35.75 = 127,270 \text{ pound-feet.}$$

$$3,560 \times 33.25 = 118,370 \text{ pound-feet.}$$

$$\text{Total Moment} = 485,085 \text{ pound-feet.}$$

$$F \frac{16^3}{122} = 485,085.$$

$$F = 14,450 \text{ pounds per square inch.}$$

The allowable fibre stress under this unbalanced load is 5,100 pounds. The calculated fibre stress is in excess of this amount,

APPENDIX J—Page 11.

and, therefore, the crossing poles "B" and "C" must be head guyed.

Side Guys (for Poles "A" and "E").

From Paragraph 641 (a) the poles must be guyed to take the transverse load due to wind and ice on entire line between the guyed poles, this transverse load being figured as taken entirely by the guys (Paragraph 651).

The transverse force acting on the poles will include the wind pressure on the ice covered pole, and the transverse force due to the wind pressure on the ice covered wires. The length of the conductor used in figuring this transverse force on each of the two guyed poles will be equal to one-half ($\frac{1}{2}$) the distance between the guyed poles, plus one-half ($\frac{1}{2}$) the length of the span adjacent to the pole, or to

$$\frac{510}{2} + \frac{120}{2} = 315 \text{ feet.}$$

Moment due to wind on pole (from Page 147) M_p
7,039 pound-feet.

Moment due to conductors—

$$M_{c_0} = 42.5 \times 1 \times .875 \times 315 = 11,714 \text{ pound-feet.}$$

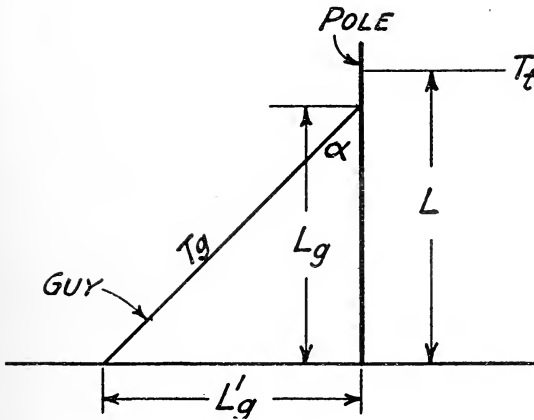
$$M_{c_1} = 38.25 \times 4 \times .839 \times 315 = 40,436 \text{ pound-feet.}$$

$$M_{c_2} = 35.75 \times 4 \times .839 \times 315 = 37,793 \text{ pound-feet.}$$

$$M_{c_3} = 33.25 \times 4 \times .839 \times 315 = 35,150 \text{ pound-feet.}$$

$$\text{Total Moment, } M_t = 132,132 \text{ pound-feet.}$$

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M_t = Total moment on pole.

L_g = Height of guy attachment from ground

L'_g = Distance of guy anchor from base of pole

T_g = Tension in guy wire

$$T_g = \frac{M_t}{L_g \sin a}$$

$$\sin a = \frac{1}{\sqrt{1 + \left(\frac{L_g}{L'_g}\right)^2}}$$

M_t = 132,132 pound-feet.

L_g = 31.5 feet

L'_g = assume = 10.5 feet

$$\sin a = \frac{1}{\sqrt{1 + \left(\frac{31.5}{10.5}\right)^2}} = .3162$$

$$T_g = \frac{132,132}{31.5 \times .3162} = 13,266 \text{ pounds} = \text{tension in side guy.}$$

APPENDIX J—Page 13.

As the specified factor of safety for guys is three (3), there would be required to meet this tension a guy having an ultimate strength of not less than 39,798 pounds. This is too heavy a guy to be practicable, and the tension in the guy should be reduced by increasing the distance of the guy anchor from the base of the pole, that is, increasing L'_g . Assume L'_g can be made equal to L_g , or to thirty-one and five-tenths (31.5) feet, then—

$$\sin a = \frac{1}{\sqrt{1 + \left(\frac{31.5}{31.5}\right)^2}} = .707$$

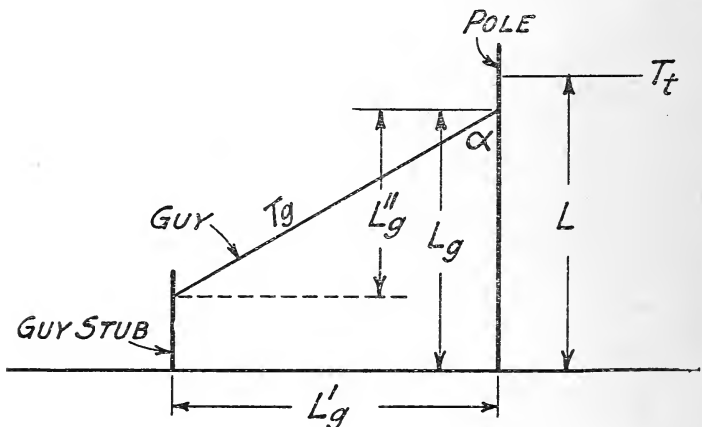
$$T_g = \frac{132,132}{31.5 \times .747} = 5,932 \text{ pounds}$$

= tension in side guy.

This would require a guy having an ultimate strength of 17,796 pounds, which could be obtained by using two Siemens-Martin seven-sixteenths (7/16) inch guy strands, each having an ultimate strength of 9,000 pounds.

Head Guying (For Poles "B" and "C.")

Total moment $M_t = 485,085$ pound-feet.
(From Page 148.)



APPENDIX J—Page 14.

$$T_g = \frac{M_t}{L_g \sin a}$$

$$\sin a = \frac{1}{\sqrt{1 + \left(\frac{L''_g}{L'_g}\right)^2}}$$

$$M_t = 485,085 \text{ pound-feet.}$$

$$L_g = 31.5 \text{ feet}$$

$$L'_g = 120 \text{ feet}$$

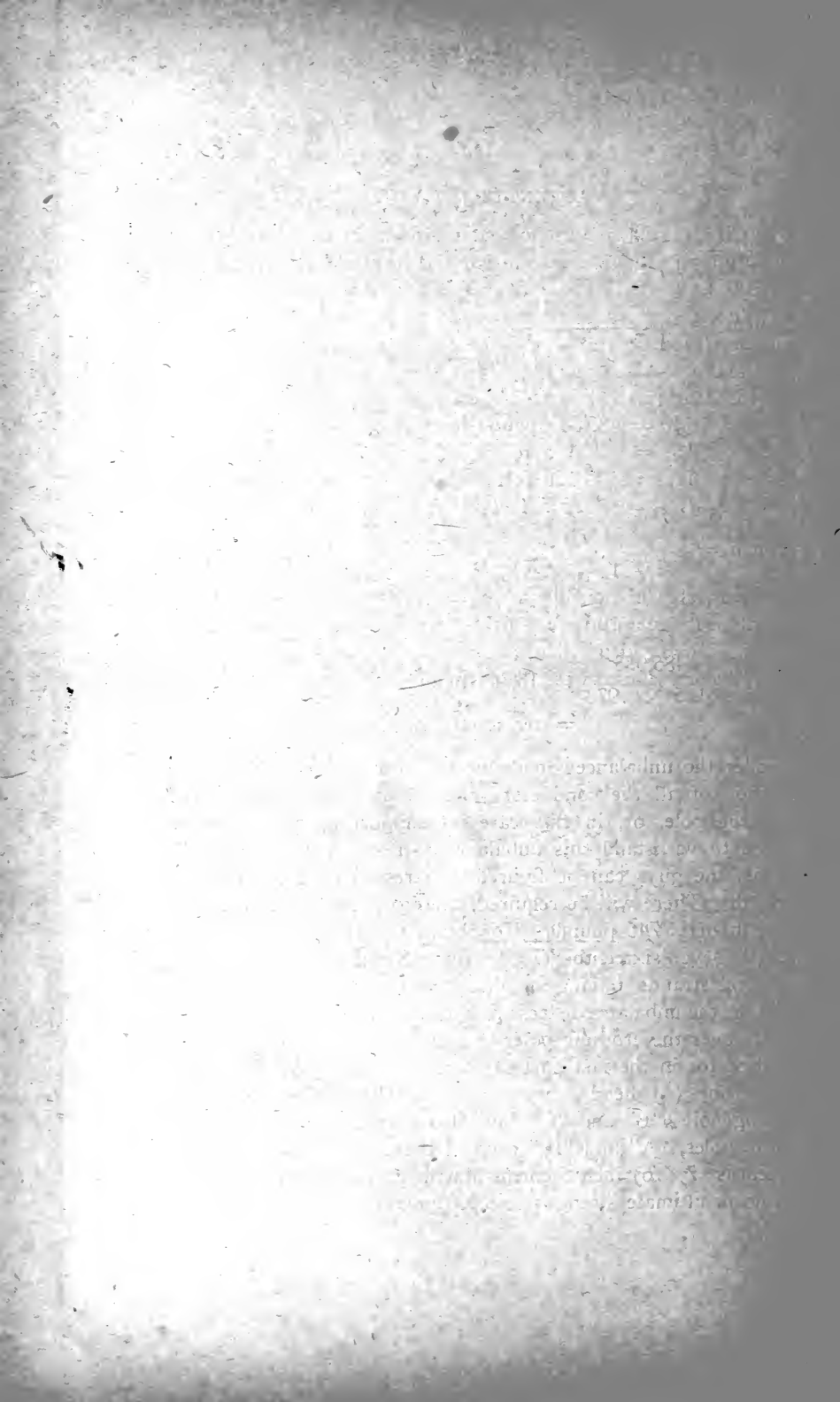
$$L''_g = 25.5 \text{ feet}$$

$$\sin a = \frac{1}{\sqrt{1 + \left(\frac{25.5}{120}\right)^2}} = .978$$

$$T_g = \frac{485,085}{31.5 \times .978} = 15,746 \text{ pounds}$$

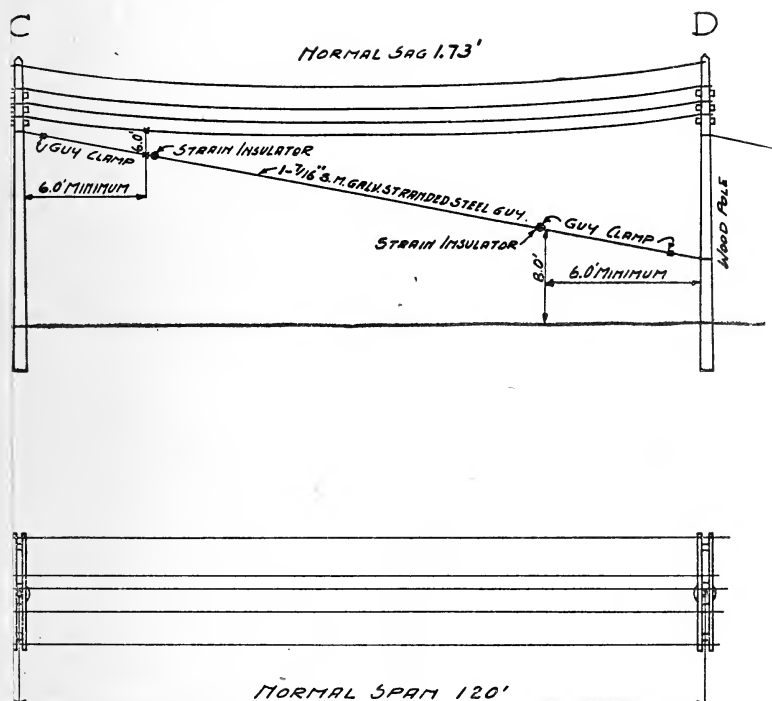
= tension in head guy.

Under the unbalanced load due to the combined pull in one direction of all the conductors under maximum conditions of load, the pole, or, in this case its supporting guys, can be figured to withstand this unbalanced stress "without failure"; that is, the guys can be figured as stressed to their ultimate strength. There will be required, therefore, guys with ultimate strength of 15,746 pounds. To obtain this, there can be used two (2) seven-sixteenths (7/16) inch Siemens-Martin galvanized steel strands, having an ultimate strength of 9,000 pounds each; or, the unbalanced stress may be assumed to be distributed equally over the crossing poles and the next adjoining poles, as provided for in the last part of Paragraph 640 (b). If so assumed, one (1) head guy may be installed on each of the crossing poles "B" and "C," and also on each of the next adjoining poles, "A" and "D," each of these guys to be a seven-sixteenths (7/16) inch Siemens-Martin galvanized steel strand, having an ultimate strength of 9,000 pounds.

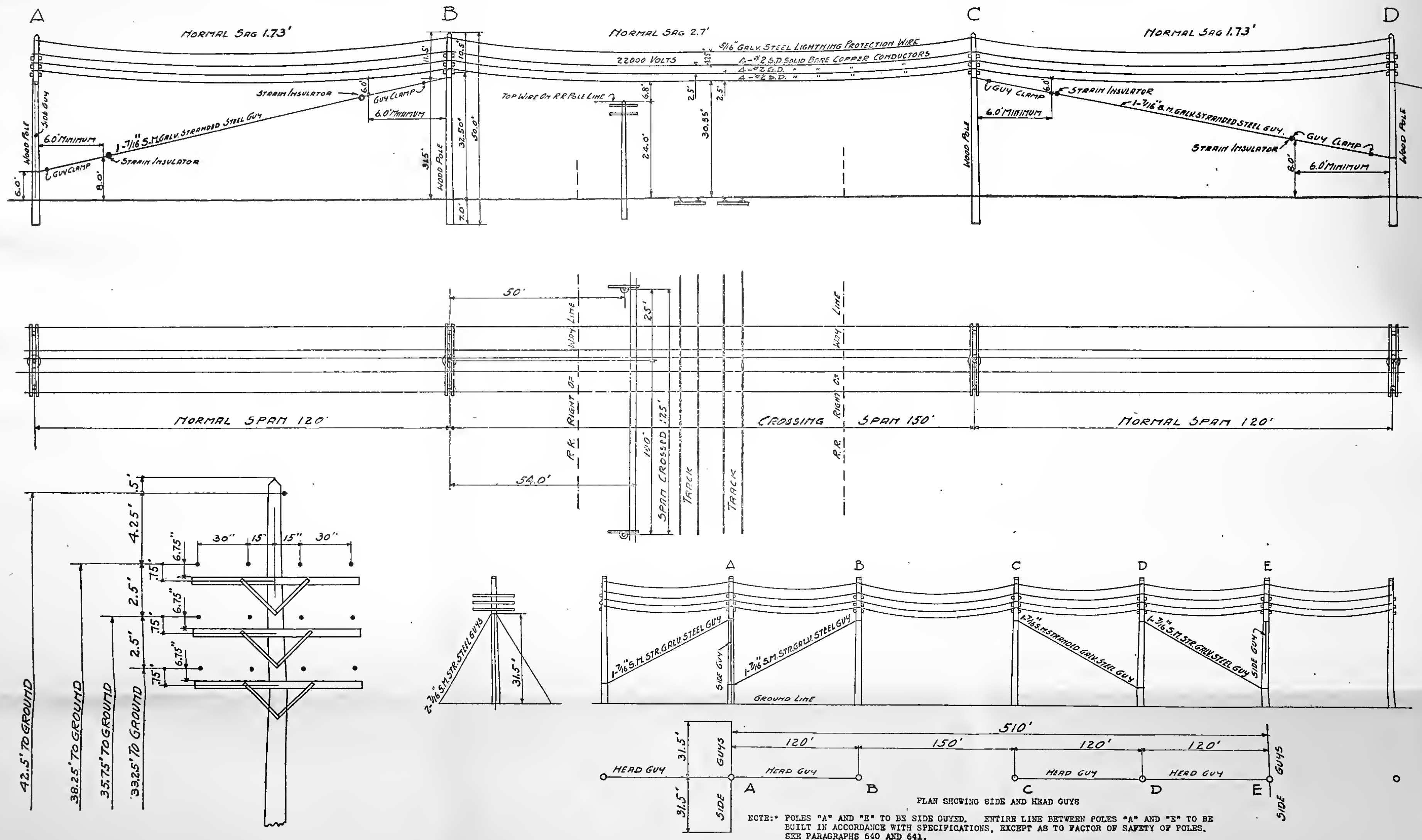


INSTRUCTION,

ded for in paragraph 641.



Poles "A" and "E" assumed to be the nearest poles at which it is practicable to install side guys, as provided for in paragraph 64i.





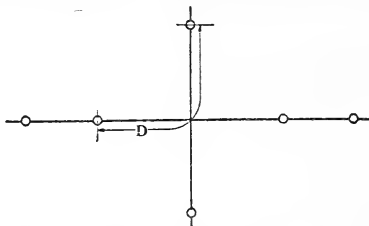
APPENDIX K. MISCELLANEOUS TABLES.

Minimum Vertical Clearances. (Under Normal Conditions.)

Paragraphs 307 and 609.

BETWEEN CONDUCTORS OF THE CROSSING SPAN AND THE SPAN CROSSED.

NOTE:—In this table clearances are given for voltages ordinarily used and for various values of the distance "D". Distance "D" is the sum of the distances from the point of crossing to the nearest pole supporting the crossing span, and from the point of crossing to the nearest pole supporting the span crossed, as shown in sketch below.



Voltage of Circuit	Clearances for various Values of "D" in feet								
	0	10	20	30	40	50	60	70	80
2,300	4' 0"	4' 2"	4' 4"	4' 6"	4' 8"	4' 10"	5' 0"	5' 2"	5' 4"
6,600	4' 0"	4' 2"	4' 4"	4' 6"	4' 8"	4' 10"	5' 0"	5' 2"	5' 4"
13,200	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"
22,000	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"
44,000	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"	6' 0"
66,000	6' 7"	6' 9"	6' 11"	7' 1"	7' 3"	7' 5"	7' 7"	7' 9"	7' 11"
110,000	11' 0"	11' 2"	11' 4"	11' 6"	11' 8"	11' 10"	12' 0"	12' 2"	12' 4"

Voltage of Circuit	Clearances for various Values of "D" in feet								
	90	100	150	200	250	300	350	400	450
2,300	5' 6"	5' 3"	6' 6"	7' 4"	8' 2"	9' 0"	9' 10"	10' 8"	11' 6"
6,600	5' 6"	5' 3"	6' 6"	7' 4"	8' 2"	9' 0"	9' 10"	10' 8"	11' 6"
13,200	6' 0"	6' 0"	6' 6"	7' 4"	8' 2"	9' 0"	9' 10"	10' 8"	11' 6"
22,000	6' 0"	6' 0"	6' 6"	7' 4"	8' 2"	9' 0"	9' 10"	10' 8"	11' 6"
44,000	6' 0"	6' 1"	6' 11"	7' 9"	8' 7"	9' 5"	10' 3"	11' 1"	11' 11"
66,000	8' 1"	8' 3"	9' 1"	9' 1"	10' 9"	11' 7"	12' 5"	13' 3"	14' 1"
110,000	12' 6"	12' 8"	13' 6"	14' 4"	15' 2"	16' 0"	16' 10"	17' 8"	18' 6"

Voltage of Circuit	Clearances for various Values of "D" in feet								
	500	550	600	650	700	750	800	900	1000
2,300	12' 4"	13' 2"	14' 0"	14' 10"	15' 8"	16' 6"	17' 4"	19' 0"	20' 8"
6,600	12' 4"	13' 2"	14' 0"	14' 10"	15' 8"	16' 6"	17' 4"	19' 0"	20' 8"
13,200	12' 4"	13' 2"	14' 0"	14' 10"	15' 8"	16' 6"	17' 4"	19' 0"	20' 8"
22,000	12' 4"	13' 2"	14' 0"	14' 10"	15' 8"	16' 6"	17' 4"	19' 0"	20' 8"
44,000	12' 9"	13' 7"	14' 5"	15' 3"	16' 1"	16' 11"	17' 9"	19' 5"	21' 1"
66,000	14' 11"	15' 9"	16' 7"	17' 5"	18' 3"	19' 1"	19' 11"	21' 7"	23' 3"
110,000	19' 4"	20' 2"	21' 0"	21' 10"	22' 8"	23' 6"	24' 4"	26' 0"	27' 8"

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Minimum Vertical Clearances.

(Under Normal Conditions.)

Paragraph 608.

BETWEEN CONDUCTORS OF THE CROSSING SPAN AND THE TOP OF THE RAIL.

NOTE:—The clearances are given for various voltages and for various lengths of span.

Voltage of Conductors	CLEARANCES FOR VARIOUS LENGTHS OF SPAN IN FEET												
	150' or less	200	250	300	350	400	450	500	600	700	800	900	1000
2,300,	27' 0"	27' 10"	28' 8"	29' 6"	30' 4"	31' 2"	32' 0"	32' 10"	34' 6"	36' 2"	37' 10"	39' 6"	41' 2"
6,600,	27' 0"	27' 10"	28' 8"	29' 6"	30' 4"	31' 2"	32' 0"	32' 10"	34' 6"	36' 2"	37' 10"	39' 6"	41' 2"
13,200,	27' 8"	28' 6"	29' 4"	30' 2"	31' 0"	31' 10"	32' 8"	33' 6"	35' 2"	36' 10"	38' 6"	40' 2"	41' 10"
22,000,	28' 6"	29' 4"	30' 2"	31' 0"	31' 10"	32' 8"	33' 6"	34' 4"	36' 0"	37' 8"	39' 4"	41' 0"	42' 8"
44,000,	29' 9"	30' 7"	31' 5"	32' 3"	33' 1"	33' 11"	34' 9"	35' 7"	37' 3"	38' 11"	40' 7"	42' 3"	43' 11"
66,000,	31' 0"	31' 10"	32' 8"	33' 6"	34' 4"	35' 2"	36' 0"	36' 10"	38' 6"	40' 2"	41' 10"	43' 6"	45' 2"
110,000,	33' 0"	33' 10"	34' 8"	35' 6"	36' 4"	37' 2"	38' 0"	38' 10"	40' 6"	42' 2"	43' 10"	45' 6"	47' 2"

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Minimum Clearances.

Paragraphs 311 and 613.

Between Any Power Conductor or Live Hardware, and Any
Portion of the Supporting Structure.
(Insulator Pins Not Included).

Voltage.	Clearance.
2,300	3.00 inches
6,600	3.00 inches
13,200	4.55 inches
22,000	6.75 inches
44,000	12.25 inches
66,000	17.75 inches
110,000	28.75 inches

Minimum Clearances.

(Under Normal Conditions).

Paragraphs 309 and 611.

Between Conductors of One Line and Guy Wires of Another
Line.

Voltage.	Clearance.
2,300	4 feet
6,600	4 feet
13,200	4 feet
22,000	4 feet
44,000	4 feet 5 inches
66,000	6 feet 7 inches
110,000	11 feet

APPENDIX K—Page 6.

MINIMUM SEPARATION OF CONDUCTORS SUPPORTED ON DISC OR SUSPENSION TYPE INSULATORS

[illegible]

Span in Feet	600			700			800			900			1000		
	12	18	24	14	21	28	16	24	32	18	27	36	20	30	40
Sag in Feet															
Voltage	22,000,....	4' 4 $\frac{1}{2}$ "	5' 0"	5' 7 $\frac{1}{2}$ "	5' 11 $\frac{1}{2}$ "	5' 10"	6' 6 $\frac{1}{2}$ "	5' 10"	6' 8"	7' 6"	6' 6 $\frac{1}{2}$ "	7' 6"	7' 3 $\frac{1}{2}$ "	8' 4"	9' 4 $\frac{1}{2}$ "
"	44,000,....	4' 8 $\frac{1}{2}$ "	5' 0"	5' 7 $\frac{1}{2}$ "	5' 11 $\frac{1}{2}$ "	5' 10"	6' 6 $\frac{1}{2}$ "	5' 10"	6' 8"	7' 6"	6' 6 $\frac{1}{2}$ "	7' 6"	7' 3 $\frac{1}{2}$ "	8' 4"	9' 4 $\frac{1}{2}$ "
"	66,000,....	6' 3"	6' 3"	6' 3"	6' 3"	6' 3"	6' 6 $\frac{1}{2}$ "	6' 3"	6' 8"	7' 6"	6' 6 $\frac{1}{2}$ "	7' 6"	7' 3 $\frac{1}{2}$ "	8' 4"	9' 4 $\frac{1}{2}$ "
"	110,000,....	8' 9"	8' 9"	8' 9"	8' 9"	8' 9"	8' 9"	8' 9"	8' 9"	8' 9"	8' 9"	8' 9"	8' 9"	8' 9"	9' 4 $\frac{1}{2}$ "

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Wind and Ice Loads.

COPPER WIRE—SOLID—BARE.

SIZE A. W. G.	Ext. Diam. Inches	Area of Conductor Sq In.	Hard Drawn		Soft Drawn		Load per Lin. Foot Vertical		Load per Lin. Ft. Horizontal	Max. Load per Lin. Ft. Resultant	Angle of Resultant Load	EA	
			Ult. Tens.	All. Tens.	Ult. Tens.	All. Tens.	Dead	Dead + $\frac{3}{4}$ " Ice				Hard Drawn E =16,000,000	Soft Drawn E =12,000,000
0,000,	.460	.1662	8,320	4,160	5,660	2,830	.641	1.239	.973	1.575	38° 10'	2,659,000	1,994,000
000,	.410	.1318	6,600	3,300	4,480	2,240	.508	1.075	.940	1.427	44° 18'	2,109,000	1,582,000
00,	.365	.1045	5,220	2,610	3,560	1,780	.403	.942	.910	1.309	44° 3'	1,672,000	1,254,000
0,	.325	.0829	4,560	2,280	2,820	1,410	.319	.833	.884	1.214	46° 44'	1,325,000	995,000
1,	.289	.0657	3,740	1,870	2,240	1,120	.253	.774	.859	1.137	49° 6'	1,052,000	789,000
2,	.258	.0521	3,120	1,560	1,780	890	.201	.673	.839	1.075	51° 15'	834,000	626,000
3,	.229	.0413	2,480	1,240	1,400	700	.159	.613	.819	1.023	53° 10'	661,000	496,000
4,	.204	.0328	1,960	980	1,120	560	.126	.564	.802	.981	54° 52'	524,000	393,000
5,	.182	.0260	1,560	780	880	440	.100	.525	.788	.946	56° 20'	416,000	312,000
6,	.162	.0206	1,240	620	700	350	.079	.491	.775	.917	57° 50'	330,000	247,000

APPENDIX K—Page 8.

Wind and Ice Loads.

COPPER WIRE—SOLID—COVERED.

SIZE. A. W. G.	Ext. Diam. Inches.	Area of Conductor Sq. In.		Hard Drawn		Soft Drawn		Load per Lin. Foot Vertical		Load per Lin. Foot Horizontal		Max. Load per Lin. Ft. Resultant	Angle of Resultant Load	EA	
		Ult. Tens.	All. Tens.	Ult. Tens.	All. Tens.	Ult. Tens.	All. Tens.	Dead	Dead + $\frac{1}{2}$ " Ice	8.0 lb. per Sq. Ft. Cond. + $\frac{1}{2}$ " Ice	8.0 lb. per Sq. Ft. Cond. + $\frac{1}{2}$ " Ice			Hard Drawn E =16,000,000	Soft Drawn E =12,000,000
0,000.	.460	1,662	4,160	5,660	2,830	.767	1,476	1,093	1,837	36° 34'	2,659,000	1,994,000			
000.	.410	1,318	3,300	4,480	2,240	.629	1,309	1,062	1,686	39° 6'	2,109,000	1,582,000			
00.	.365	1,045	2,610	3,560	1,780	.502	1,133	1,010	1,518	41° 45'	1,672,000	1,254,000			
0.	.325	.0829	2,280	2,820	1,410	.407	1,029	1,000	1,434	44° 14'	1,326,000	995,000			
1.	.289	.0657	1,870	2,240	1,120	.316	.909	.968	1,328	46° 50'	1,052,000	789,000			
2.	.258	.0521	1,560	1,780	890	.260	.843	.958	1,276	48° 41'	834,000	626,000			
3.	.229	.0413	1,240	1,400	700	.199	.763	.937	1,208	50° 50'	661,000	496,000			
4.	.204	.0328	1,960	980	560	.164	.698	.906	1,143	52° 21'	524,000	393,000			
5.	.182	.0260	1,560	780	440	.135	.660	.896	1,113	53° 37'	416,000	312,000			
6.	.162	.0206	1,240	620	350	.112	.627	.885	1,084	54° 41'	330,000	247,000			

APPENDIX K—Page 9.

Wind and Ice Loads.
COPPER WIRE—STRANDED—BARE.

SIZE A. W. G.	Ext. Diam. Inches	Area of Conductor Sq. In.	Hard Drawn		Soft Drawn		Load per Lin. Foot Vertical		Max. Load per Lin. Ft. Resultant	Angle of Resultant Load	EA	
			Ult. Tens.	All. Tens.	Ult. Tens.	All. Tens.	Dead	Dead + $\frac{3}{4}$ " Ice			Hard Drawn E =16,000,000	Soft Drawn E =12,000,000
500,000, ..	.814	.3924	23,540	11,770	13,340	6,670	1.540	2.357	2.649	27° 8'	6,278,000	4,709,000
450,000, ..	.772	.3635	21,200	10,600	12,020	6,010	1.390	2.181	2.481	28° 30'	5,656,000	4,242,000
400,000, ..	.728	.3141	18,850	9,420	10,680	5,340	1.240	2.004	2.311	29° 52'	5,026,000	3,769,000
350,000, ..	.681	.2750	16,500	8,250	9,340	4,670	1.080	1.815	2.133	31° 42'	4,400,000	3,300,000
300,000, ..	.630	.2354	14,120	7,000	8,020	4,010	.926	1.629	1.958	33° 40'	3,770,000	2,825,000
250,000, ..	.575	.1963	11,780	5,890	6,680	3,340	.772	1.441	1.783	36° 3'	3,141,000	2,356,000
0,000, ..	.528	.1662	9,980	4,990	5,660	2,830	.653	1.292	1.645	38° 14'	2,659,000	1,994,000
000, ..	.470	.1318	7,900	3,950	4,480	2,240	.518	1.121	1.489	41° 6'	2,109,000	1,582,000
00, ..	.418	.1045	6,280	3,140	3,560	1,780	.411	.982	1.363	43° 52'	1,672,000	1,254,000
0, ..	.373	.0829	4,980	2,490	2,820	1,410	.326	.870	1.262	46° 28'	1,326,000	995,000
1, ..	.332	.0657	3,940	1,970	2,240	1,120	.258	.776	1.179	48° 51'	1,051,000	788,000
2, ..	.292	.0521	3,120	1,560	1,780	890	.205	.698	1.108	50° 0'	834,000	625,000
3, ..	.260	.0413	2,480	1,240	1,400	700	.163	.636	1.054	52° 51'	661,000	496,000
4, ..	.232	.0328	1,960	980	1,120	560	.129	.584	1.008	54° 34'	525,000	394,000
5, ..	.206	.0260	1,560	780	880	440	.102	.541	.969	55° 57'	416,000	312,000
6, ..	.184	.0206	1,240	620	700	350	.081	.506	.938	57° 20'	330,000	247,000

APPENDIX K—Page 10.

COPPER WIRE—STRAINED—COVERED.														
SIZE A. W. G.	Ext. Diam. Inches	Area of Conductor Sq. In	Hard Drawn		Soft Drawn		Load per Lin. Foot Vertical		Load per Lin. Ft. Horizontal	Max. Load per Lin. Ft. Resultant	Angle of Resultant Load	EA		
			Ult. Tens.	Ult. Tens.	Ult. Tens.	Ult. Tens.	Dead	Dead + $\frac{1}{4}$ " Ice				8.0 lb. per Sq. Ft. Cond. + $\frac{3}{4}$ " Ice	Hard Drawn E =16,000,000	Soft Drawn E =12,000,000
500,000, ..	1.108	.3924	23,530	11,770	13,340	6,670	1.894	2.894	1.405	3.217	25° 50'	6,278,000	4,709,000	
450,000, ..	1.070	.3535	21,200	10,600	12,020	6,010	1.724	2.701	1.380	3.032	27° 3'	5,656,000	4,242,000	
400,000, ..	1.020	.3141	18,840	9,420	10,680	5,340	1.553	2.498	1.347	2.838	28° 18'	5,026,000	3,769,000	
350,000, ..	.978	.2750	16,500	8,250	9,370	4,670	1.345	2.264	1.319	2.619	30° 13'	4,400,000	3,300,000	
300,000, ..	.930	.2354	14,120	7,060	8,020	4,010	1.174	2.064	1.287	2.432	31° 58'	3,770,000	2,825,000	
250,000, ..	.862	.1963	11,780	5,890	6,680	3,340	.985	1.832	1.241	2.217	34° 7'	3,141,000	2,356,000	
0,000, ..	.785	.1662	9,980	4,990	5,660	2,830	.800	1.599	1.190	1.993	36° 38'	2,659,000	1,994,000	
000, ..	.728	.1318	7,800	3,950	4,480	2,240	.653	1.417	1.152	1.826	39° 6'	2,109,000	1,582,000	
00, ..	.662	.1045	6,280	3,140	3,560	1,780	.522	1.245	1.108	1.666	41° 39'	1,672,000	1,254,000	
0, ..	.605	.0829	4,980	2,490	2,820	1,410	.424	1.111	1.070	1.542	43° 54'	1,326,000	995,000	
1, ..	.518	.0657	3,940	1,970	2,240	1,120	.328	.961	1.012	1.395	47° 27'	1,051,000	788,000	
2, ..	.440	.0521	3,120	1,560	1,780	890	.270	.855	.960	1.285	48° 21'	834,000	625,000	
3, ..	.408	.0413	2,480	1,240	1,400	700	.206	.771	.939	1.214	50° 37'	661,000	496,000	
4, ..	.379	.0328	1,960	980	1,120	560	.170	.717	.919	1.165	52° 5'	525,000	394,000	
5, ..	.351	.0260	1,560	780	880	440	.140	.669	.902	1.122	53° 24'	416,000	312,000	
6, ..	.327	.0206	1,240	620	700	350	.115	.629	.885	1.086	54° 36'	330,000	247,000	

Wind and Ice Loads.
ALUMINUM WIRE—STRAINED—BARE.

Copper Equiv. C. M. or A. W. G.	Size C. M.	Ext. Diam. Inches	Area of Conductor Sq. In.	Ult. Tens.	All Tens.	Load per Lin. Foot Vertical		8.0 lb. per Sq. Ft. Cond. + $\frac{1}{2}$ " Ice	Max. Load per Lin. Ft. Resultant	Angle of Resultant Load	EA E=9,000,000
						Dead	Dead + $\frac{1}{2}$ " Ice				
500,000, ..	795,000	1.0255	.6240	14,360	7,180	.732	1.631	1.350	2.156	38° 4'	5,616,000
450,000, ..	715,500	.9737	.5620	12,920	6,460	.658	1.575	1.316	2.052	39° 52'	5,058,000
400,000, ..	636,000	.9184	.5000	11,500	5,750	.585	1.467	1.279	1.946	41° 4'	4,500,000
350,000, ..	556,500	.8555	.4370	10,060	5,030	.512	1.355	1.237	1.835	42° 24'	3,933,000
314,500, ..	500,000	.8115	.3926	9,040	4,520	.460	1.276	1.208	1.757	43° 26'	3,533,000
300,000, ..	477,000	.7925	.3745	8,620	4,310	.439	1.243	1.195	1.724	43° 50'	3,370,000
250,000, ..	397,500	.7235	.3120	7,180	3,590	.365	1.126	1.149	1.608	45° 39'	2,808,000
0,000, ..	336,420	.6570	.2640	6,080	3,040	.310	1.030	1.105	1.511	47° 53'	2,376,000
188,600, ..	300,000	.6280	.2356	5,420	2,710	.276	.978	1.085	1.461	48° 0'	2,120,000
000, ..	266,800	.5853	.2095	4,820	2,410	.246	.921	1.057	1.402	48° 55'	1,885,000
00, ..	211,950	.5220	.1665	3,840	1,920	.181	.831	1.015	1.312	50° 40'	1,498,000
0, ..	167,800	.4644	.1318	3,040	1,520	.155	.755	.976	1.234	52° 19'	1,860,000
1, ..	133,220	.4140	.1045	2,400	1,200	.123	.632	.943	1.170	53° 46'	940,000
2, ..	103,530	.3634	.0829	1,900	950	.097	.537	.912	1.113	55° 6'	746,000
3, ..	83,642	.3279	.0657	1,520	760	.077	.592	.885	1.066	56° 16'	591,000

Wind and Ice Loads.
STEEL WIRE—STRANDED—GALVANIZED.

SIZE	Diam. Inches	Area Sq. In.	Siemens-Martin		High Tension		Load per Lin. Foot Vertical		Load per Lin. Foot Horizontal	Max. Load per Lin. Ft. Resultant	Angle of Resultant Load	EA
			Ult. Tens.	All Tens.	Ult. Tens.	All Tens.	Dead	Dead $\frac{3}{4}$ " Ice				
5/8, .....	.6250	.2356	19,000	9,500	25,000	12,500	.821	1.520	1.083	1.867	35° 28'	6,832,000
9/16, .....	.5625	.1922	14,500	7,250	21,100	10,550	.668	1.329	1.042	1.689	38° 2'	5,574,000
1/2, .....	.5000	.1443	11,000	5,500	18,000	9,000	.510	1.132	.999	1.510	41° 28'	4,185,000
7/16, .....	.4375	.1204	9,000	4,500	15,000	7,500	.415	.998	.958	1.383	43° 25'	3,492,000
3/8, .....	.3750	.0832	6,800	3,400	10,500	5,250	.295	.839	.917	1.243	47° 52'	2,413,000
5/16, .....	.3125	.0606	4,860	2,430	8,100	4,050	.210	.715	.875	1.130	50° 43'	1,757,000

SIZE

E=29,000,000

Angle of Resultant Load

Max. Load per Lin. Ft. Resultant

8.0 lb. per Sq. Ft. Cond. Ice

Load per Lin. Foot Vertical

High Tension

Siemens-Martin

Area Sq. In.

Diam. Inches

APPENDIX L

**ALLOWABLE NUMBER OF No. 4 SOLID COPPER, TRIPLE
BRAIDED, WEATHER-PROOF WIRES TO BE CARRIED BY
CHESTNUT POLES.**

Conforming to Specifications given in Appendix "B."

Loading— $\frac{1}{2}$ inch Ice.

4 Lbs. per Sq. Ft. Wind Pressure.

Allowable Unit Fiber Stress—2500 Lbs. per Sq. In.

NOTE:—"Special" pole is a Class "A" pole; 5 feet longer than the specified length, cut off 5 feet at the top. The use of 6-pin cross-arms is assumed unless otherwise indicated.

THIS TABLE FOR USE WITH SECTION II ONLY.

LENGTH OF POLE	Length of Span	ALLOWABLE NUMBER OF WIRES			
		Special pole	Class "A" pole	Class "B" pole	Class "C" pole
30,	100	†*24	†*24	†*24	†22
	125	†*24	†*24	†23	17
	150	†*24	†*24	†19	14
	200	†*24	†19	14	10
35,	100	†*40	†*40	†32	24
	125	†37	†33	28	19
	150	†31	29	22	15
	200	24	20	16	11
40,	100	†49	42	39	30
	125	42	35	30	23
	150	36	28	24	18
	200	25	20	17	13
45,	100	66	50	46	32
	125	47	37	34	25
	150	37	30	28	20
	200	26	21	20	15

*Limited by clearance.

†Requires 8-pin cross-arms.

(Table continued on page 168).

Sec. IX.

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APPENDIX L—Page 2.

LENGTH OF POLE	Length of Span.	ALLOWABLE NUMBER OF WIRES			
		Special pole	Class "A" pole	Class "B" pole	Class "C" pole
50,	100	66	52	48	35
	125	49	39	36	27
	150	39	31	29	22
	200	28	23	21	16
55,	100	70	56	52	38
	125	52	42	39	30
	150	41	34	32	24
	200	29	24	23	18
60,	100	74	60	56	.....
	125	55	45	43	.....
	150	44	36	34	.....
	200	31	26	25	.....
65,	100	82	64	60	.....
	125	58	48	45	.....
	150	46	39	37	.....
	200	33	28	27	.....
70,	100	82	68	64	.....
	125	61	51	48	.....
	150	49	41	39	.....
	200	35	30	28	.....
75,	100	93	73	68	.....
	125	69	55	52	.....
	150	55	44	42	.....
	200	39	32	30	.....
80,	100	97	82	77	.....
	125	72	62	59	.....
	150	58	50	47	.....
	200	41	36	34	.....

APPENDIX L—Page 3.

ALLOWABLE NUMBER OF No. 4 SOLID COPPER, TRIPLE
BRAIDED, WEATHER-PROOF WIRES TO BE CARRIED BY
WESTERN CEDAR POLES.

Conforming to Specifications given in Appendix "B."

Loading— $\frac{1}{2}$ inch Ice.

4 Lbs. per Sq. Ft. Wind Pressure.

Allowable Unit Fiber Stress—2600 Lbs. per Sq. In.

NOTE:—"Special" pole is a Class "A" pole; 5 feet longer than the specified length, cut off 5 feet at the top. The use of 6-pin cross-arms is assumed unless otherwise indicated.

THIS TABLE FOR USE WITH SECTION II ONLY.

LENGTH OF POLE	Length of Span	ALLOWABLE NUMBER OF WIRES			
		Special pole	Class "A" pole	Class "B" pole	Class "C" pole
30,	100	†*24	†*24	†*24	16
	125	†*24	†*24	†19	12
	150	†*24	†20	16	10
	200	†19	15	11	7
35,	100	†*40	†33	24	16
	125	†32	28	19	12
	150	29	22	15	10
	200	20	16	11	7
40,	100	42	39	24	16
	125	35	29	19	13
	150	28	24	15	10
	200	20	17	11	8
45,	100	45	38	25	17
	125	34	29	19	13
	150	27	23	16	11
	200	20	17	11	8

*Limited by clearance.

†Requires 8-pin cross-arms.

(Table continued on page 170).

Sec. IX.

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APPENDIX L—Page 4.

LENGTH OF POLE	Length of Span.	ALLOWABLE NUMBER OF WIRES			
		Special pole	Class "A" pole	Class "B" pole	Class "C" pole
50,	100	44	37	25	18
	125	33	29	19	14
	150	27	23	16	11
	200	19	17	12	8
55,	100	47	38	26	19
	125	36	29	20	15
	150	29	24	16	12
	200	21	17	12	9
60,	100	48	41	27	18
	125	36	32	21	14
	150	30	26	17	12
	200	21	19	13	8
65,	100	48	42	28	19
	125	37	33	22	15
	150	30	27	18	12
	200	22	19	13	9

APPENDIX L—Page 5.

**ALLOWABLE NUMBER OF No. 4 SOLID COPPER, TRIPLE
BRAIDED, WEATHER-PROOF WIRES TO BE CARRIED BY
EASTERN WHITE CEDAR POLES.**

Conforming to Specifications given in Appendix "B."

Loading— $\frac{1}{2}$ inch Ice.

4 Lbs. per Sq. Ft. Wind Pressure.

Allowable Unit Fiber Stress—1500 Lbs. per Sq. In.

NOTE:—"Special" pole is a Class "A" pole; 5 feet longer than the specified length, cut off 5 feet at the top. The use of 6-pin cross-arms is assumed unless otherwise indicated.

THIS TABLE FOR USE WITH SECTION II ONLY.

LENGTH OF POLE	Length of Span	ALLOWABLE NUMBER OF WIRES			
		Special pole	Class "A" pole	Class "B" pole	Class "C" pole
30,	100	†*24	†23	17	13
	125	†23	18	13	10
	150	†19	15	11	8
	200	14	11	8	6
35,	100	†32	25	16	13
	125	27	19	12	10
	150	21	16	10	8
	200	15	11	7	6
40,	100	36	29	21	16
	125	27	22	16	12
	150	22	18	13	10
	200	16	13	9	7
45,	100	37	30	24	18
	125	28	23	19	14
	150	23	19	15	11
	200	17	14	11	8

†Requires 8-pin cross-arms.

*Limited by clearance.

(Table continued on page 172.)

Sec. IX.

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APPENDIX L—Page 5.

LENGTH OF POLE	Length of Span.	ALLOWABLE NUMBER OF WIRES			
		Special pole	Class "A" pole	Class "B" pole	Class "C" pole
50,	100	38	31	25	19
	125	30	24	20	15
	150	24	20	16	12
	200	17	14	12	9
55,	100	40	33	27	21
	125	31	26	21	16
	150	25	21	17	13
	200	18	15	13	10
60,	100	42	35	30	23
	125	33	28	23	18
	150	27	22	19	15
	200	19	16	14	11

Consideration of Specifications by the General Committee:

In conformity with the motion authorizing the appointment of the sub-committee, its report was to be submitted to the General Conference for consideration and action. Accordingly a call was issued by the Chief of the Bureau of Engineering for a General Meeting to be held for this purpose on July 20, 1915. Invitations to attend and take part in the discussion were sent to all of the General Conference Members and to many others who had expressed a desire to be present at such a meeting.

The further action taken in these matters will be discussed in the Annual Report of the Bureau for the fiscal year ending June 30, 1916.



PART VI.

UNIFORM SERVICE RULES FOR WATER UTILITIES.

GENERAL.

In connection with the early work of the Commission it soon developed that it would be highly desirable to attempt a standardization of the service rules and the rates and tariffs in use by the various water companies throughout the State. It was not the idea to formulate absolute standards in all of these matters but rather to draw up rules and regulations that would make for uniformity of action and procedure throughout the State. It was for the purpose of aiding the Commission in the solution of problems of this kind that standing committees were appointed by the various State utility organizations. Accordingly a conference was arranged between the standing committee of the Pennsylvania Water Works Association and a committee of the Pennsylvania Public Service Commission.

CONFERENCE OF MARCH 15th, 1915.

On this date a meeting was held in Harrisburg at which were present the Committee of the Public Service Commission consisting of Chairman Pennypacker, Counsel Trinkle, Chief Wilson of the Bureau of Rates and Tariffs, and Chief Snow of the Bureau of Engineering and the following Committee representing the Pennsylvania Water Works Association:

W. C. Hawley, Chairman of the Executive Committee of the Association and Manager of the Pennsylvania Water Company, Wilkesburg, Pa.

J. W. Wilson, of the Lehigh Water Company, Easton, Pa.

F. S. Purviance, Secretary of the Association, Pittsburgh, Pa.

J. H. Purdy, American Water Works and Electric Company, New York City.

J. L. Ledoux, Springfield Consolidated Water Company, Philadelphia, Pa.

J. N. Chester, Edgewood Water Company, Pittsburgh, Pa.

H. D. Brown, President of Williamsport Water Company, Williamsport, Pa.

Morris Knowles, Consulting Engineer, Pittsburgh, Pa.

Following a lengthy discussion of the problems before the Conference, it was determined that the Committee of the Association

should meet and draw up a set of general rules and regulations to form the basis of discussion in another conference with representatives of the Commission. It was further decided that Chiefs Wilson and Snow should meet with the State Committee and take part in its deliberations.

MEETING OF APRIL 16th—17th, 1915.

The above mentioned meeting was held in Atlantic City, and was attended by Messrs. Hawley, Chairman, Purdy, J. W. Wilson, Montgomery Evans, Knowles, Ledoux, Purviance, Brown and Chiefs Wilson and Snow of the Public Service Commission. Following an afternoon spent in general discussion the committee was sub-divided, Messrs. Purdy, Ledoux and Brown, meeting with Mr. Snow to formulate standard service rules and Messrs. Hawley, Wilson, Evans, Knowles and Purviance meeting with Chief Wilson, to consider questions of uniformity in rates and tariffs: The evening and the second day of the conference were given up by the sub-committee to the study and preparation of uniform service rules. A tentative set of rules was adopted by the sub-committee for presentation to the Committee of the State Association for its criticism and general consideration prior to being submitted to The Public Service Commission. The conference adjourned to meet again at the call of the chair.

CONFERENCE OF APRIL 29th, 1915.

On this day a conference was held in Philadelphia at which were present Chiefs Wilson and Snow of the Public Service Commission and the following members of the standing committee of the Pennsylvania Water Works Association: Messrs. Hawley, Purdy, Ledoux, Evans, J. L. Wilson, Brown, Chester, Knowles, and MacCullum, also Assistant Chief Ehlers of the Bureau of Engineering.

The conference was called for the purpose of further consideration of uniform service rules adopted tentatively at the meeting held in Atlantic City on April 16th, and 17th, 1915. The entire day was devoted to the work and at the conclusion of the day's discussion a uniform set of service rules had been agreed upon. It was decided that the question of a uniform schedule of rates, etc. would be taken up at some subsequent meeting of the general committee. The service rules adopted by the conference and submitted to the Commission for its consideration under date of May 3rd, 1915, are given in full hereinafter. No further action was taken in this matter during the rest of the fiscal year, either by the Commission or by the Engineering Bureau.

SUGGESTED UNIFORM SERVICE RULES.

"EXPLANATORY: The water company is duly chartered to supply pure and wholesome water in adequate quantity throughout the chartered territory in the public highways, streets and lanes where reasonable service is required and warranted. Furthermore, it is the duty of the company to install, maintain, and operate such facilities as are adequate to properly render such service.

In order to make these facilities and service on the part of the water company effective, property owners, architects and builders must necessarily perform certain duties, furnish standard materials and observe certain rules. The company supplies premises and not individuals. First, the service is to be rendered, or the ready-to-serve facilities of the system are available for fire protection, public or private; Second, for domestic use; and, third, for commercial and general purposes. This service may be supplied by meter or flat rate under the following general rules:

APPLICATION FOR SERVICE.

- 1—Water will be furnished, or service connection made upon written application by the owner, or his properly authorized agent, on a blank prepared by the company for the purpose, and after approval of such application by the company endorsed thereon.
- 2—A new application must be made and approved by the company on any change in ownership of property, or in the service, as described in the application, and the company shall be at liberty upon five days' notice to discontinue the water supply until such new application has been made and approved.

CONNECTIONS.

- 3—Water will be supplied through any connection or supply line, if inspected in the open trench and approved by the company. The company will make all connections to its mains.
- 4—The curb-box, curb-stop-cock, and ferrule and coupling at the connection of the service-line with the main line shall always be accessible to and under the control of the water company whether owned by the company or applicant.
- 5—Service lines shall be used to supply a single building only and no building shall be supplied by more than one service line, unless otherwise approved or ordered by the company. Where two or more buildings are supplied through a single service line any violation of the rules of the company with reference to either or any of said buildings shall be deemed a violation as to all, and the company may take such action as can be taken for a single building.

- 6—All connections, service lines, fixtures and meters when furnished by the applicant shall be maintained by him in good order. All leaks in service or any other pipe or any of the fixtures in or upon the premises supplied must be immediately repaired by the owner or occupant of the premises.
- 7—Where the service line is owned by the applicant, the company shall in no event be responsible for maintaining the service line or for damage done by water escaping therefrom, or for lines or fixtures on applicant's property, and applicant shall at all times comply with municipal regulations with reference thereto, and make changes therein required on account of changes of grade, relocation of mains or otherwise.
- 8—No service line shall be laid in any trench wherein are laid gas pipes, sewer pipe, or any other facilities of a public service company or municipality, unless authorized and approved by the company.
- 9—The company will prescribe the size and weight per foot of pipe and the quality of all materials which shall be allowed between the main and the building to be supplied, or meter.

METERS.

- 10—Meters shall be conveniently located so as to control the entire supply and a proper place and protection therefor shall be provided by applicant. A flat-way stop-cock shall be placed on the service line on the street-side of and near the meter, and a stop and waste cock on the other side of the meter. A suitable check-valve shall be placed between the stop and waste cock and the meter, if required by the company.
- 11—Meters to be used shall be of styles and character approved by the company and subject to the inspection and approval of the company. When furnished by the applicant, the meter shall be maintained by and at the expense of the applicant and shall at all times be accessible to proper agents of the company.
- 12—The applicant shall notify the company of any injury to or the non-working of the meter whether furnished by the applicant or the company as soon as the same comes to his knowledge. When a meter furnished by the applicant becomes damaged in any way or fails to register, the applicant shall, upon five days' notice from the company, advance to it the cost of repairing, retesting and replacing the meter, or shall make other arrangements for having it put promptly into working order. In the latter case the applicant shall deliver the meter, when it has been repaired, to the company for testing, and re-installation.

- 13—Meters, when owned by the company, will be maintained by the company so far as ordinary wear and tear are concerned; but damage due to freezing, hot water, or external causes shall be paid for by the applicant.
- 14—In case of a disputed account involving the accuracy of a meter, such meter shall be tested upon the request of the applicant, in conformity with the provisions of the Rules and Regulations pertaining to Water Service Utilities of The Public Service Commission of the Commonwealth of Pennsylvania. In the event that the meter so tested is found to have an error in registration of four per cent. or more, the bill will be corrected accordingly.
- 15—Where water is furnished by flat rate, the company shall have the right to install, maintain and inspect a meter to detect waste and the owner shall provide a suitable location therefor. The company also reserves the right to install a meter and furnish water by meter-rate only, in which case the owner of the property shall provide a suitable location therefore, but the meter shall be furnished and maintained by the company.
- 16—Where water is furnished by meter, the quantity recorded by it shall be conclusive on both the applicant and the company, except when the meter has been found to be registering inaccurately or has ceased to register. In such case the quantity may be determined by the average registration of the meter when in order, or by such other fair and reasonable method as shall be based upon the best information obtainable.

DISCONTINUANCE OF SERVICE.

- 17—Service under an application may be discontinued for any of the following reasons:
- a—For misrepresentation in application as to property or fixtures to be supplied or the use to be made of the water supply,
 - b—For use of water for any other property or purpose than that described in the application,
 - c—Under flat-rate service, for adding to said property or fixtures or the use to be made of the water supply, without notice to the company,
 - d—For wilful waste of water through improper or imperfect pipes, fixtures, meters or otherwise,
 - e—For failure to maintain the meter, or connections, service-lines, or fixtures in good order when furnished by applicant,

- f—For neglecting to make or renew advance payment, or for non-payment of any account for water supplied, or for meter or service maintenance,
 - g—For molesting any service pipe, meter, curb-stop-cock, seal, or any other appliance of the company controlling or regulating the water supply,
 - h—In case of vacancy of premises,
 - i—For the violation of any rules of the company.
- 18—Water will be turned off of any premises upon the written order of the applicant without in any way affecting the existing application.
- 19—As necessity may arise, in case of break-down, emergency or other unavoidable cause, the company shall have the right to temporarily cut off the water supply and to make necessary repairs, connections, etc.; but the company will use all reasonable and practicable measures to notify the consumer of such discontinuance of service. In such case the company shall not be liable for any damage or inconvenience suffered by the applicant.

RENEWAL OF SERVICE.

- 20—Service will be renewed under a proper application when the conditions under which such service was discontinued are corrected and upon the payment of charges provided in the schedule of rates, or tariffs, of the company.

CONSTRUCTION SERVICE.

- 21—A metered* supply of water for building or other such purposes, except in a lot or premises already supplied, must be specially applied for. Such a supply will be furnished on an application for a domestic supply, and may be included under a previous application when special application therefor is duly made and accepted.
- 22—Water for building purposes, when not furnished by meter, will be supplied under a special application. All use of water by other than the applicant, or for any purpose or upon any premises not stated or described in the application must be prevented by him. The applicant will be liable for the amount of water used in conformity with the schedule of rates, or tariffs, of the company.

GENERAL.

- 23—The company shall have the right to reserve a sufficient supply of water at all times in its reservoir to provide for fire and other emergencies, or may restrict or regulate the quantity of water used by consumers in case of scarcity or whenever the public welfare may require it.
- 24—The company will not be liable for a claim made against it for any interruption in service, lessening of supply, inadequate pressure, or inferior quality of water due to causes beyond its control.
- 25—All pipes, meters and fixtures shall at all reasonable hours be subject to inspection by employes of the company identified by proper badge.
- 26—No water fixture will be considered cut off until it is disconnected so that it cannot be used again without the aid of a plumber, or is sealed in a manner satisfactory to the company.
- 27—No plumber, owner or other unauthorized person shall turn the water on or off at any corporation stop or curb stop or disconnect or remove the meter without the consent of the company.
- 28—No person except the superintendent or other authorized person shall take water from any public fire-hydrant, plug-street-washed, drawcock, hose-pipe, or fountain, except for fire purposes, or for use of the fire department in case of fire, and no public fire-hydrant shall be used for sprinkling streets, flushing sewers, or gutters, or for any other than fire purposes, unless permitted by the company.
- 29—No agent or employe of the company shall have the authority to bind it by any promise, agreement or representation not provided for in these rules.

EXTENSIONS.

- 30—The company will extend its mains within its chartered territory on public roads, streets and lanes upon application when the revenue is sufficient to pay the operating expense, depreciation, fixed and overhead charges, and a fair return on the capital investment therefor under a proper system of accounting.

PART VII.

REPORTS OF SPECIAL INTEREST.

GRADE CROSSING ELIMINATION PROBLEMS.

Berks County.

The Reading Chamber of Commerce and the Berks County Farm Bureau made a joint petition for the elimination of certain dangerous grade crossings of highways and steam railroads in Cumru and Robeson townships. The petition signed by 158 citizens of Berks County alleged that the grade crossings of the State Highway, known as Route No. 147 and the Pennsylvania Railroad at High's Lane and of said State Highway and the parallel tracks of the Pennsylvania Railroad and the Philadelphia and Reading Railway at Ridgewood, Gibraltar and Robeson are dangerous and should be eliminated. After a hearing before the Commission at Harrisburg on August 19th, 1914, the matter was referred to the Bureau of Engineering for a field investigation and report. A few days later a party comprising officials of the two railroad companies, the county commissioners, the township authorities, various attorneys and officers of the Chamber of Commerce and the Farm Bureau and private citizens in company with the engineer of the Commission, viewed the premises at each of the grade crossings mentioned in the petition and discussed the subject of elimination. It was admitted by all that the crossings were dangerous and that it would be fair for the county, the railroads and the State to assume their proportionate share of the cost of elimination and possibly the townships also but it was stated by the county commissioners that there were other grade crossings in the suburbs of the city of Reading and elsewhere in the county of Berks that were equally dangerous and should be eliminated. The concensus of opinion seemed to be that the Public Service Commission should make a survey of all grade crossings within a reasonable radius of the city of Reading, classify them, make estimates of cost of elimination and prepare a comprehensive report and program for the protection and gradual elimination of the grade crossings in Berks County, on the basis of which the county commissioners, the railroad companies and the State Highway Department might estimate their proportionate share of the cost of such protection and elimination and thus be enabled to make necessary and adequate plans to obtain the money. The county commissioners did not care to agree to contribute to the cost of eliminating the said grade crossings along State Highway Route No. 147 until they knew how much the county's proportion of the cost of eliminating all of the grade crossings in Berks County might be. In consequence, I was authorized to examine and report upon the protection and gradual elimination of all of the grade crossings in Berks County excluding those in the city of Reading. The reason for excluding the city grade crossings was that they may more properly be considered as a separate problem.

In outlining the survey, the subject of crossings was divided into two parts, namely protection of crossings and elimination of crossings.

Protection of Crossings.

All grade crossings should be protected in some way or manner. The least protection is a warning sign erected on the highway at a proper distance on either side of the railroad. The most expensive protection is gates operated by a watchman 24 hours a day.

Urban Protection.—It is assumed that in the urban district the protection of the grade crossing should be by means of gates operated by a watchman, or a flagman, or by means of audible signal, such as electric signal bells, or audible and visible signals combined. The objection to the track signal bell in the residence district is that the noise therefrom may be objectionable.

In the thickly built up section of the city or the borough, gates operated by an attendant do not absolutely keep pedestrians off the crossing especially in the rush hours of street traffic. They do, however, quite effectually keep vehicles off the crossing. But even in this case it is proven that gates are not an absolute obstacle to vehicles, and due to this inadequacy accidents and fatalities have occurred at grade crossings protected by gates. Nevertheless, in thickly built up districts gates afford the best and most efficient form of protection known. It is obvious that if a gate does not keep pedestrians off a crossing or the railroad tracks, that a flagman without gate could not do so. There are many accidents on the railroad right of way in urban districts due to the trespassing of persons. Some railroad companies have endeavored by policing their rights of way and through the making of occasional arrests to minimize, if not wholly prevent accidents due to trespassing upon railroad property. Where grade crossings are eliminated in a city, such trespassing is naturally much less than where the crossings are at grade and pedestrians can easily get upon the railroad property.

Leaving out of consideration the trespasser along the railroad right of way, and since a flagman alone is not as efficient as a gate and watchman at a grade crossing to keep pedestrians off the crossing and bells are objectionable on account of noise, it follows as a logical conclusion from the standpoint of theory that every grade crossing in the urban district should be protected by a gate and watchman and of course at night all urban crossings at grade should be thoroughly lighted; but in practice this theory is seldom, if ever, lived up to or required by the municipal authorities for reasons which appear to be mutually satisfactory to the citizens, the town authorities and the railroad officials.

Suburban Protection—The same process of reasoning and conclusions would seem to hold good for the suburban district, although there may be crossings in the outskirts of the suburban district where the track signal bell would not be objectionable and would be sufficient.

The use of the highways is greater in the urban district than in the suburban district and greater in the suburban district than in the rural district. While it is quite possible that there may be no more train movements over the line of the railroad in the urban district than in the rural district, it is evident that the danger is greater in the urban district, hence it is the use by pedestrians and vehicles of the crossing rather than the use of the tracks by railroad operations that increases the degree of

danger and dictates the necessary degree of protection required. The accidents at crossings in the urban district obtain more with pedestrians; but in the rural districts they obtain more with vehicles. Gates are the highest form of protection that can be afforded the pedestrian, as previously stated, and when this is not sufficient a good reason exists for the elimination of the grade crossing.

Rural Protection—It does not follow that in the rural district gates should be provided at the crossing. The use of many highway crossings in the country is so small that some other form of protection than gates ought to be sufficient. It is assumed that where a flagman is stationed without a gate, that the pedestrian traffic is relatively small and that the vehicular traffic is considerable. Where the flagman is not on duty 24 hours of the day, the highway is an important thoroughfare and hence the traffic may be considerable at night, the grade crossing may be sufficiently protected by a flagman during the day time and an audible and visible signal at night.

All rural crossings should be so maintained as to afford an adequate view of the railroad in both directions. Trees or embankments or other obstructions to view should be removed or in lieu thereof the crossing should be protected by a flagman, a track signal bell or an audible visible signal.

Where warning signs, or obstructions to view which cannot be removed economically, require more protection to safeguard the public, the next step in affording protection is the installation of a track signal bell or the audible visible type. If the head light on locomotives were the powerful search light throwing profuse illumination on the crossing at a distance of 2,000 feet or more, thus giving ample and flash light warning of the approach of the train or showing up any stalled automobile or other obstruction on the tracks at the crossing soon enough for the train to come to a stop before reaching the crossing, then the track signal bell might be dispensed with in the rural districts; but good railroad practice is against such illumination.

Discussion as to Protection—The above suggestion if carried out generally would involve substantial changes with respect to the protection of grade crossings now afforded. The present means such as signs, lighting, signal bells, flagman, gates, cattle guards and fencing have become established by custom determined upon by township, county, municipal and State officials, railroad officials, the practice of the courts and by statute. Prudence would dictate that if the above suggestions were to be applied to so large a division of the State, as a county, or to the State as a whole, a comprehensive knowledge obtained from an actual survey of the protection now afforded in such unit of territory and its adequacy or insufficiency should be had, and afterwards that a conference of the municipal, state and private corporations interested should be held, to permit of free discussion and full understanding of the purpose and practicability of a state wide policy of protection, before a general order in relation thereto were issued by the Public Service Commission.

Elimination of Grade Crossings

The best of protection possible to afford at a grade crossing has its limitations. The drivers of vehicles sometimes lose control of the motor or the horses. Sometimes the motor becomes stalled at the railroad track. Street cars crowded with patrons have been struck by a train on this account. Users

of the highway not infrequently become confused or fail for some reason to pay attention to the sign, signal, flagman or gate; or they wilfully pass by the protection and voluntarily assume the risk of crossing the track. Consequently accidents occur and will continue to occur over which the railroad company cannot have adequate control.

Furthermore, in the city or town, the occupation of the highway crossing by the railroad train for many minutes at a time delays highway traffic to an extent amounting to serious interference with the public convenience and necessity. Sometimes fire apparatus responding to an alarm is held up because of a freight train on a crossing. The seriousness of delay to public business is measured to quite an extent by the highway use of the crossing, so that finally for these reasons it is agreed by the railroad company and the municipal authorities that the benefits to accrue from eliminating the grade crossing warrants the cost, and plans are adopted and the changes and improvements are effected. Out in the rural district, the delay in highway traffic is not a large factor. Safety is the principal thing there. Hence in studying the problem of eliminating grade crossings, it is best to approach the subject from the standpoint first, of the urban district, second the suburban district, and third the rural district.

Urban Elimination—Quite often it is not found practicable from the standpoint of cost to eliminate a grade crossing in the town. It may be, and often is true, that the avoidance of an existing grade crossing can be accomplished only by a change in the highway grade and the railroad grade. If a change in the railroad grade is involved, it may affect more than one crossing in the town and if so, the problem becomes a comprehensive one involving a general project and corresponding expense. Consequently, the parties concerned will suffer great inconvenience in delayed highway traffic and delayed train movements and endure hazardous risks to the point that it becomes intolerable. In fact, in a number of towns in Pennsylvania through which trains on the main line cannot be run at express speed, it has been found necessary by the railroad company to further the interests of its business, to reconstruct the line of the railroad around the town as the cheapest way out of the difficulty; but there are other places where this solution of the problem is not practicable or where the benefits accruing therefrom would not be commensurate with the enormous expense involved, and in such cases grade crossings have to be put up with until the money is in sight to separate the grades. So in considering the elimination of grade crossings in Berks County or any other county, where there is a big city and numerous boroughs and good sized villages, and where the money requisite to abolish all the grade crossings cannot be secured in an interval of a few years, a gradual elimination must be devised based on the ability to pay and this dictates that there shall be a classification of crossings into the most dangerous, the dangerous and the least dangerous crossings. In the city it follows as a general rule that the most dangerous crossing is the one most used, upon the assumption that every crossing in the city is safeguarded by proper protection. There may be peculiar circumstances as to street grades or view to be had approaching the railroad, or the alignment of the railroad and movement of trains across the highway, which operate to distinguish and make some crossings more dangerous than others. Where such circumstances have caused accidents, more than at other crossings in the city than are used to a greater extent, such crossing will be classed as most dangerous.

A railroad sustaining many movements a day over the crossing makes that crossing more dangerous, generally speaking, than where there is very much less train movement. These matters must be taken into account in classifying the crossings in the city, and hence these three divisions, the most dangerous, the dangerous and the least dangerous applied to urban crossings, should be applied as judgment and the circumstances warrant and quite differently from the application of the principle to crossings in the rural district. A comprehensive plan should be studied for the elimination of all of the grade crossings in the city and the cost should be estimated. It should then be determined whether the entire work must be done all at one time or whether parts of the work cannot be done and at different times, spread over a series of years, so that the elimination will be gradual; and a conclusion should be reached and a program agreed to for the progress and the financing of the improvement. In a lesser degree this arrangement may obtain in some of the boroughs.

Suburban Elimination—In the suburbs which might also include small boroughs and villages, one of the first things to determine is whether the railroad grades are to be changed or the highway grades are to be changed or both are to be changed and how this shall be done to bring about ultimately an elimination of all of the grade crossings, and then when the cost is estimated and the plan is adopted, the next move is to determine what if any part of the cost is to be imposed upon the municipality, the railroad company, the state and other interests concerned and whether the elimination shall be left to the initiative of all or any one of the parties concerned. It stands to reason that the most dangerous crossing should be eliminated first, if they can be taken up singly; if not, then the work must be postponed until the money is forthcoming to do the work all at one time.

Rural Elimination—In the rural districts there is greater opportunity for error in judgment in classifying the crossings. It may not follow absolutely that the most used highway in the rural district is the most dangerous crossing. The view of the railroad from the approaches and the kind and amount of traffic on the highway are factors. At a certain rural crossing where fatalities have occurred, the victims have been farmers coming in early to town on market days with their products. This is an example of how the kind of use of a highway may make a particular crossing dangerous in fact.

Conclusions:

At the end of the year covered by this report the Bureau had practically completed the field work of investigating all of the grade crossings in Berks County. A report will be submitted early in the following year. The above considerations have guided the Bureau in its studies and classification of the crossings. It is possible that with this Berks County work as a guide, similar studies will be taken up in the other counties of Pennsylvania with the object in view of laying before the Commission the existing facts upon which a program for the proper protection of grade crossings and the gradual elimination of them can be most intelligently determined.

GRADE CROSSING NEAR ERIE.

Early in the year the East Erie Commercial Railroad Company asked for permission to construct its proposed railroad at grade in Harbor Creek Township across three highways known as Six Mile Creek Road, Buffalo Road and Clowe Road. The Commission instructed the Bureau to investigate the matter and to report not only a plan for the avoidance of these grade crossings but also to report a plan for the elimination of the existing crossings at grade of these said three highways by the tracks of the Lake Shore and Michigan Southern Railroad and the tracks of the New York, Chicago and St. Louis Railroad, more popularly known as the "Nickel Plate." This problem involved a study of the suburbs of the city of Erie lying to the east and a cursory examination of the question of grade crossing elimination within the city limits.

General Conditions:

The city of Erie is an industrial community occupying a compact, rectangular area, located on Lake Erie and on the harbor shore and bounded on three sides by Mill Creek Township. In the city proper there reside upwards of 70,000 people. In Mill Creek Township to the east many hundred acres of ground have been purchased by the Pennsylvania General Electric Company and on this tract of land works have been laid out which when completed will give employment to 10,000 workmen. This industrial corporation has also laid out the town, a water works system, sewerage and drainage system, lighting plant and other facilities for a community of 50,000 people. These plans, insofar as required by law, have been approved by the several State departments having jurisdiction.

Passing through the city and the suburbs including Mill Creek Township and the township of Harbor Creek to the east is the main line of the Lake Shore and Michigan Southern Railroad comprising 4 to 15 or more parallel tracks. Paralleling this main line and not many hundred feet distant therefrom is the main line of the said "Nickel Plate" Railroad—principally a single track road.

There is a highway approaching from the east and entering Erie city known as the Buffalo Road. It is the main thoroughfare for automobiles and other highway traffic between Buffalo and Erie. This highway for part of its length through Harbor Creek Township lies close to and north of the said main lines of railroad and for the other part near Erie City and through Mill Creek Township the said highway lies to the south of the said main line, the crossing being at grade in Harbor Creek Township. At this crossing there have been a number of fatalities and it is widely known in Erie County as "Dead Man's Crossing."

In the city of Erie the two railroads cross public highways at a total of 40 places, 31 being at grade. The Erie and Pittsburgh Railroad and the Bessemer and Lake Erie Railroad enter the city from the west and parallel the tracks of the said Lake Shore Railroad. The Philadelphia and Erie Railroad enters the city from the east and parallels the said Lake Shore Railroad for quite a distance. All told, these five railroads cross public highways at 70 places in Erie and all but 13 are grade crossings. This total does not include the Pennsylvania Railroad or other tracks along the harbor front. For 10 years or more, the problem of abolishing grade crossings in the city has been before the public in Erie and negotiations have been carried on with the several railroad companies. Experts have been employed, plans have been devised, and still the project is not settled. State street, French Street and Liberty Street have been carried under the railroad at a considerable cost. These changes with particular reference to State and French streets, are temporary only.

It is known and partially agreed that the railroad tracks at these streets will eventually have to be elevated some 6 or 8 feet. No plan has yet been devised which deals with the whole question comprehensively and whatever is done for a permanent solution must necessarily involve a large expenditure of money and the period of construction must extend over several years approximately a decade. However, it is probable that the grade of the railroads will remain as at present in the eastern part of the city at the crossing of the Lake Shore and Michigan Southern tracks by the tracks of the Philadelphia and Erie which crossing is at grade. Beyond this railroad grade crossing to the east, the tracks of the Lake Shore Railroad cross but one highway in the city, namely, at East Avenue, which is a grade crossing. The "Nickel Plate" Railroad passes over and above the grade of said avenue and the tracks of the Philadelphia and Erie Railroad. Beyond the city to the east in Mill Creek Township and in Harbor Creek Township, as far as Harbor Creek village, the public roads crossed by the Lake Shore and the "Nickel Plate" Railroads are as shown in the following tabular statement. These crossings are all at grade:

Public Highway Crossing (at grade).	Distance in Miles.	
	From City Line.	From Crossing next west.
Mill Creek Township:		
1. Adams Road,	0.66	.....
2. Franklin Ave.,	1.33	0.67
3. Crowley Avenue,	2.10	0.75
Harbor Creek Township:		
4. Lee (Negley) Road,	2.66	0.55
5. Walbridge Road,	3.40	0.75
6. Six Mile Creek Road,	4.15	0.75
7. Buffalo Road,	4.55	0.40
8. Clowe Road,	5.30	0.75
9. Station Road,	5.55	0.25

Taking up these crossings in order, the Adams Road Crossing is not within the property interests of the Pennsylvania General Electric Company.

Franklin Avenue is the western boundary of a tract of land about one mile in extent, known as the Works Plot of said General Electric Company. This territory is set aside for the shops and mills and the industrial plant of said company. The plot is bounded on the east by Crowley Road and 4 Mile Creek; on the south by the two steam railroads, namely the Lake Shore and the "Nickel Plate" and on the north by East Lake Avenue. Crowley Road begins at East Lake Avenue and extends southerly to Wesleyville borough, a settlement of about 200 inhabitants now, but growing rapidly and located just south of the two railroads. Plans are projected for the change of location of Crowley Road and for the passing of it under and beneath the grade of the railroad.

The elimination of the Franklin Avenue crossing and the Adams Road crossing may also be considered separate and independent improvements, since the railroad grades will not be changed at these points and each crossing may be eliminated independently of the others and at different times.

At Crowley Road there are 7 tracks of the Lake Shore Railroad and 50 feet to the south there is the single track of the "Nickel Plate" Railroad. This crossing is dangerous and is unprotected except by signs.

East of Four Mile Creek is the village of Lawrence Park, lying partly in Mill Creek Township and partly in Harbor Creek Township. Ultimately this place will become a city and so it is laid out. Passing through what in the near future will be the centre of this community is Lee Road, extending north

and south. Where this highway is crossed by the railroads there are 10 parallel tracks of the Lake Shore (they being a part of a local freight yard a mile or more in length) and there are two tracks of the "Nickel Plate" Railroad. There is no protection afforded to the travelling public at this crossing except the warning sign.

The Walbridge Road crossing is three quarters of a mile farther east. Here there are five tracks of the Lake Shore Railroad and a single "Nickel Plate" track. Warning signs are the only protection afforded at this crossing.

Six Mile Creek is in a ravine which is crossed by the railroad on an earthen embankment and bridge. In said ravine and a few hundred feet west of the creek there is an underpass beneath the grade of the said two railroads which was built at the expense of and for the use of the Buffalo and Lake Erie Traction Company trolley line extending between Buffalo and Erie. This trolley line for most of its length is located in and along the Buffalo Road which is a main State Highway Route in Pennsylvania. In extending easterly to Buffalo this trolley line is laid along and in this State Highway from Wesleyville to near Six Mile Creek where it deflects to the north and passing through the said underpass and under the two steam railroads, thence deflects to the east and continues easterly across the creek and at grade across Six Mile Creek Road and thence adjacent to and paralleling the Lake Shore Railroad to the north to the Buffalo Road where it crosses at grade the said two railroads, and thence the trolley line is built in and along said State Highway to the north of the railroads to Harbor Creek Township village and beyond. From the underpass there is a branch of the trolley line which extends westerly north of the railroad to and through Lawrence Park to East Lake Avenue and thence back into the city.

At the Six Mile Creek Road crossing there is the single track of the trolley line, 4 tracks of the Lake Shore Railroad and the single track of the "Nickel Plate" Railroad. This highway extends north and south between the Buffalo Road and East Lake Avenue and the territory traversed by it is farm land with one dwelling only on its length.

The Buffalo Road crossing is peculiarly dangerous. There are four parallel tracks of the Lake Shore Railroad and 50 feet distant there is the single track of the "Nickel Plate" Railroad, and immediately north of the Lake Shore Railroad there is the track of the trolley line. The highway crosses the railroad tracks and the trolley line perpendicularly. Whether the vehicle approaches this crossing from the east or the west, it must make two abrupt right angle changes in its course, either one of which is practically at a railroad track. The State Highway parallels the railroad tracks; one portion is north and the other part is south of the railroads, their ends being connected by the perpendicular crossing at grade of the railroad tracks. These tracks are the main lines of train movements from the east and west. Here the limited passenger trains speed by at the rate of 70 miles an hour or more at times. The alignment of the railroad tracks is straight and the grade is substantially level for several miles. At this crossing all four tracks may be occupied at the same time, trains going in different directions and at different speeds. The writer saw all of the railroad tracks occupied by trains in motion and to add to the confusion, a trolley car was approaching. There is no protection now afforded the travelling public at this point on this main thoroughfare except an electric light maintained by the trolley company over its track and the customary warning sign posts.

Three quarters of a mile farther east is the Clowe Road crossing. The number of tracks here and their relative position is the same as at the Buffalo Road crossing, but the highway grades ascend and descend to reach the crossing of

the steam railroad tracks since the latter are laid on an earthen embankment high above the surrounding ground.

About half a mile farther east is a township, road grade crossing at the Harbor Creek passenger station. The problem of eliminating one or both of these grade crossings and whether one or the other should be entirely abandoned, can be settled without reference to a change in the grade of the railroad tracks. Because it is admitted by all engineers conversant with the situation that the grade of the Lake Shore Railroad Company's tracks should not be materially changed between Harbor Creek Station and the east line of Erie City.

Proposed Extension of the East Erie Commercial Railroad:

The petitioner now operates a railroad which begins at or near Franklin Avenue and thence extends easterly by and along the Lake Shore Railroad, and north of it, for about a mile to Crowley Road. This section is operated electrically on the Third rail plan; thence continuing easterly and paralleling the Lake Shore Railroad but at a distance of about 300 feet to the north, the said East Erie Commercial Railroad is constructed and operated on its own right of way as a trolley line, crossing at grade Crowley Road, Lee Road and Walbridge Road and terminating near Six Mile Creek.

It is from this road near Six Mile Creek that the said East Erie Commercial Railroad Company purposes to extend its trolley line still further easterly, terminating for the time being at or near Station Road in the village of Harbor Creek. By the plan proposed the extension will cross Six Mile Creek road at grade adjacent to the Lake Shore tracks and thence the said trolley extension line on its own right of way adjacent to and north of the said Lake Shore Railroad, crossing at grade the Buffalo Road and the Clowe Road. In order to carry out this plan the existing track of the Buffalo and Lake Erie Traction Company must be moved over farther north to avoid a crossing with the East Commercial Railroad and so also will it become necessary to move farther north a portion of the Buffalo Road.

Discussion:

The petitioner will undertake to acquire the land and to defray the expense of carrying out the plans described and the petitioner will at any time assume its proportionate shares of the cost of eliminating the Buffalo Road grade crossing.

The East Commercial Railroad Company, in testing its electric locomotives may operate over the proposed line at a rate of speed in excess of 40 miles per hour. It is not necessary or desirable to establish the proposed grade crossing. To the contrary public necessity requires the elimination of the grade crossings now existing in the territory in discussion as fast as this may be practicable.

It having been determined by the Bureau and agreed to by various other engineers interested that such elimination beginning at the easterly city line of Erie and extending towards Buffalo should not involve any substantial change in the grade of the steam railroads, the solution of the problem is simplified to this extent. It seems practicable at this time to assume that a wise plan should provide for at least one crossing of the railroad tracks for every mile of railroad track and that the highways should either be carried above or below the existing grade of the railroad. It is perfectly feasible to abandon the crossing at grade of the railroads and the Buffalo Road and of the railroads and the Six Mile Creek Road and to substitute therefor one crossing

below the grade of the tracks of the railroads at or near the point where the trolley line of the Buffalo and Lake Erie Traction Company now passes under the railroads near Six Mile Creek. This plan would call for a permanent crossing at Harbor Creek Station to the east and a permanent crossing at or near Walbridge Road to the west and it would further require the laying out of an extension of the Buffalo Road north of the Lake Shore Railroad from the present Buffalo Road crossing to the proposed underpass, an approximate distance of 2600 feet.

A conference with the engineers of the petitioner, the trolley company, the State Highway Department and the two steam railroad companies and with members of the Board of Trade or Chamber of Commerce of Erie resulted in an agreement that this plan was the best one to adopt. Consequently plans were jointly prepared and specifications and estimates of cost. Near the close of the year the Public Service Commission having declared that the Buffalo Road crossing and the Six Mile Creek Road crossing were dangerous and should be eliminated, the said plans and specifications were adopted, hearings were held and the vacation of these two crossings were ordered and the substitute plan was put into effect with the exception that the damages and the proportionate share of the cost to be assessed upon the respective interests concerned were undetermined.

MINERS MILL VIADUCT.

In the first annual report of the Bureau, the Wilkes-Barre Connecting Railroad project was fully described. It comprised the construction of a double track railroad for the operation of freight trains only around the city of Wilkes-Barre from Hudson to Buttonwood, a distance of 7 miles to be used jointly by the Delaware & Hudson Company and the Pennsylvania Railroad Company. In Miners Mills borough the Central Railroad of New Jersey crosses Mill Street at grade and also crosses at grade a street railway near Mill Street. The Wilkes-Barre Connecting Railway Company proposes to build double tracks across Mill Street at grade and across the said street railway at grade. The new tracks will be parallel to and not over 100 feet distant from the said Central Railroad tracks. They will be 8 feet higher in elevation because Mill Street rises on a steep grade here. The situation is a dangerous one. Practically all the travel from Plains village to Miners Mills borough uses this crossing. It is perfectly practicable to avoid this grade crossing as a highway and the street railway by the construction of an overhead street viaduct that shall carry the trolley and the street traffic. This would mean the abolition of two existing grade crossings and the prevention of two additional grade crossings.

The borough of Miners Mills, Luzerne County, having objected to the establishment of a grade crossing at Mill Street by the tracks of the Wilkes-Barre Connecting Railway Company, the Public Service Commission directed that said company prepare plans for the avoidance of the said grade crossing and the crossing at grade by the said railroad of the tracks of the Wilkes-Barre Railway Company located near Mill Street on its own right of way. The chief engineer of the Wilkes-Barre Connecting Railway Company, at a hearing given by the Commission on October 6th, 1914, presented alternate plans for a steel viaduct that should carry the public traffic and also the said trolley line over Mill Street and the tracks of the Central Railroad Company of New Jersey and the parallel tracks of the Wilkes-Barre Connecting Railroad. These plans

were referred to the engineer of the Commission. These plans were rejected and the Commission ordered that the engineers of the said railroad companies, the said trolley company and the borough of Miners Mills confer with the engineer of the Commission in an attempt to reach an agreement as to the type of structure and the location of the bridge to avoid not only the crossing of the public highway and the trolley track by the said connecting railroad, but to also eliminate the existing crossings at grade of the Central Railroad Company of New Jersey at Mill Street and at the trolley track. This conference was had in the office of the Bureau and an agreement was reached in writing with respect to the general type of structure and its location and dimensions. The plan for the bridge agreed upon provided for a steel viaduct with proper approaches and for a vertical clearance between the top of the rails of the steam railroads and the lowest portion of the bridge over the tracks of 20 feet. Subsequent to this conference the town council of the borough of Miners Mills by resolution substantially agreed to the plans. The plans as finally agreed to call for the abandonment of Mill Street at the points of crossing between the lines of the rights of way of the two railroad companies and to substitute therefore an overhead crossing at a new location in the neighborhood by the construction of a steel viaduct and earthen embankment approaches thereto, leading from Mock Street over Mill Creek and the right of way and tracks of the Central Railroad of New Jersey and of the Wilkes-Barre Connecting Railroad to Abbott Street and Mill Street.

The Bureau examined every property that is to be affected by the said changes, placed a value on the property as at present situated, and a value after the changes shall have been made, taking into account the land and property taken and the consequential damages by reason of the taking and the changes involved in the plan, based on the testimony heard before the Commission and the view of the property.

The Bureau also prepared a written description of each property.

The Commission found and determined that in the construction of the said crossing and in the abolition of the existing grade crossings it is necessary or proper to take or injure certain pieces of land and did take said pieces of land for the purpose of said crossings, and ascertained and determined the following amounts as compensation for said damages:

Land containing 1655 square feet, coal reserved, being the property of Thomas S. Napko, to the owner of which the Commission ascertained and determined that there is due no damages, for the reason that any injury or damages is offset by the benefits of said improvement.

Land containing 225 square feet, coal reserved, being the property of the Asher Miner Hose Company, to the owner of which the Commission ascertained and determined that there is due as compensation for damages for property taken, injured or destroyed, the sum of \$60.

Land containing 8,321 square feet, coal reserved, "excepting and reserving to the grantors hereto, their heirs, successors and assigns, a right to ingress and egress over, through and upon a part of the land above described, being a strip of land 12 feet in width and about 55 feet in length, lying along the southerly end of the above described piece of land, and adjoining the lands of the Asher-Miner Hose Company, and extending from the Miner Road to the other lands of the grantor herein," being the property of the Miner-Hilliard Milling Company, to the owner of which the Commission ascertained and determined that there is due, as compensation for damages for property taken, injured or destroyed, the sum of \$2,010.

Also a certain lot situate in the borough of Miners Mills, having a front of 200 feet more or less on the easterly side of Mill Street and extending back a

depth of 75 feet more or less to the property of the Wilkes-Barre and Suburban Street Railway Company and to Mill Creek, being the property known and described as the "Johns Lot" and being now owned by the Miner Hilliard Milling Company, to the owner of which the Commission ascertained and determined that there is due, as compensation for damages for property taken, injured or destroyed, the sum of \$680.

Land containing 11,136 square feet, coal reserved, being the property of Evan Price, to the owner of which the Commission ascertained and determined that there is due, as compensation for damages for property taken, injured or destroyed, the sum of \$8,625.

Land containing 4,500 square feet, coal reserved, being the same parcel of land conveyed by William Tasker to the Wilkes-Barre and Suburban Street Railway Company, by deed dated the 30th of October, 1888; also one other piece or parcel of land, being a strip 25 feet in width, being the same land conveyed by Issac M. Thomas, et al., executors of Jesse Thomas, deceased, to the Wilkes-Barre and Suburban Street Railway Company, by agreement dated July 5, 1889, except out of the same a strip of land crossing the above described land and being 50 feet in width lying equal distant on both sides of the present railroad tracks of the Lehigh Coal and Navigation Company; also one other piece of land, situate in Plains Township, being a part of lands conveyed to the Wilkes-Barre and Suburban Street Railway Company by the Fairmount Land Co., all being the property of the Wilkes-Barre and Suburban Street Railway Company, to the owner of which the Commission ascertained and determined that there is due, as compensation for damages, for property taken, injured or destroyed, the sum of \$5,465.

A parcel of land being the property of the Hudson Coal Company, to the owner of which the Commission ascertained and determined that there is due as compensation for damages to property taken, injured or destroyed the sum of \$215.

A parcel of land being the property of the Wilkes-Barre Connecting Railroad Company, to the owner of which the Commission ascertained and determined that there is due as compensation for damages for property taken, injured, or destroyed, the sum of \$1,314, said parcel containing 13,500 square feet.

A certain parcel of land in the township of Plains containing 90 square feet, being the property of the Wilkes-Barre Connecting Railroad Company to the owner of which the Commission ascertained and determined that there is due as compensation for damages for property taken, injured or destroyed, the sum of \$50.

A certain parcel of land containing 1,800 square feet of land being the property of John Thompson and located in the township of Plains, to the owner of which the Commission ascertained and determined that there is due as compensation for property taken, injured or destroyed the sum of \$420.

A certain parcel of land in the township of Plains containing 4,640 square feet, being the property of Michael Mozola, to the owner of which the Commission ascertained and determined that there is due, as compensation for property taken, injured or destroyed, the sum of \$600.

A certain parcel of land in the township of Plains containing 1,540 square feet being the property of Jacob Hinz, to the owner of which the Commission ascertained and determined that there is due as compensation for the property taken, injured or destroyed, the sum of \$200.

A certain parcel of land in the township of Plains containing 943 square feet being the property of Mary Zukowski, to which the owner of which the Commission ascertained and determined that there is due as compensation for property taken, injured or destroyed the sum of \$100.

A certain parcel of land in the township of Plains containing 500 square feet to the owner of which the Commission ascertained and determined that there is due as compensation for property taken, injured or destroyed the sum of \$100.

A certain parcel of land in the township of Plains containing 1,125 square feet being the property of Mary Martynkowski, to the owner of which the Commission ascertained and determined that there is due, as compensation for property taken, injured or destroyed, the sum of \$100.

A certain parcel of land in the township of Plains containing 2,750 square feet being the property of William Rutledge, to the owner of which the Commission ascertained and determined that there is due as compensation for property taken, injured or destroyed, the sum of \$200.

A certain parcel of land in the township of Plains containing 3,900 square feet being the property of Thomas J. Hughes, to the owner of which the Commission ascertained and determined that there is due, as compensation for property taken, injured or destroyed, the sum of \$400.

A certain parcel of land in the township of Plains containing 425 square feet, being the property of Morgan Bevan, to the owner of which the Commission ascertained and determined that there is due, as compensation for property taken, injured or destroyed, the sum of \$15.

The report of the Commission goes on to state:

"The lease-hold estate of Peter Begonas in all that certain piece of property described as No. 4 above and being more specifically described in a certain lease presented by said Begonas, the term of which expires on the first day of April, 1917, to the owner of which the Commission ascertains and determines that there is due, as compensation for damages to property taken, injured or destroyed, the sum of \$600.

"The Commission hereby ascertains and determines that the compensation for the above described damages for property taken, injured or destroyed, in said improvement is the sum of \$21,154. After investigation and hearing it is estimated that the cost of construction of the proposed improvement will be \$61,520 making the total cost of the construction and the damages incident thereto \$82,674.

"In determining the proportionate contribution to the above mentioned total expense of the proposed improvement, the Commission has taken into consideration the importance of the service rendered or to be rendered to the public by various public service companies interested and the benefits which will be derived from said construction by the companies, as well as the public. The safety of the public using Mill Street as a crossing and the safety of the operation of the existing crossing of the tracks of the Wilkes-Barre Railway Company over the tracks of the Central Railroad Company of New Jersey have been given due weight by the Commission in this determination. The proposed construction will afford to the general public, as well as to the users of the Wilkes-Barre Railway Company, a crossing which will be for all time safe and adequate and will eliminate dangers which, in the opinion of the Commission, existed in the operation of the two crossings under the condition presented by the testimony in this case. The fact that the grade crossing of the railway company over the tracks of the Central Railroad Company of New Jersey has existed for a number of years and that no accident has occurred at said crossing has been taken into consideration by the Commission in proportioning the amount which shall be paid by the Wilkes-Barre Railway Company in eliminating a condition which the

Commission considers unsafe and capable of change without undue expense being upon the railway company. The fact that a grade crossing has existed for a number of years does not justify its continuance where its elimination can be accomplished without burdening the public service company with an unreasonable expense.

"Likewise, the improvement in the facilities which the proposed viaduct will give to the residents of Miners Mills is deemed of such importance that the Commission is of the opinion that the borough of Miners Mills should contribute to the cost of the abolition of the Mill Street crossing and the substitution therefor of the new viaduct.

"The Central Railroad Company of New Jersey will, by the improvement proposed, be relieved of two crossings at grade within a short distance of each other, and the Commission is, therefore, of the opinion that it should contribute a reasonable amount to the expense of the improvement.

"The Wilkes-Barre Connecting Railroad is being constructed for the purpose of removing from the congested streets of the city of Wilkes-Barre a large amount of traffic which has for a number of years rendered crossings in this city very dangerous. A large number of trains will be run by said railroad over the tracks which it proposes to construct at the places involved in the crossings in Miners Mills. The necessity and desirability of constructing the Wilkes-Barre Connecting Railroad are clearly set out in the petition filed in this case and are fully sustained by the testimony produced at the hearings. The railroad company adopted its route and determined its grade in the district involved with full knowledge that its alignment would be such as to make it necessary either to aggravate the conditions at the two crossings mentioned or to provide some substitute for these crossings. While the Commission is not of the opinion that the Wilkes-Barre Connecting Railroad Company should, for this reason, be forced to pay the entire cost of this improvement, which will benefit both the other public service companies and the municipality, it is of the opinion that, in view of the priority of location of the other public service companies and in view of the facts above mentioned, the applicant should reasonably be called upon to bear the greatest part of the expense which the Commission finds it necessary to assess in order to render the operation of all the public service companies safe and efficient.

"Having carefully considered all the facts brought to its attention by the testimony, and having given due weight to the reasons advanced by all of the parties on the subject of the distribution of the expense of this improvement, the Commission is of the opinion and finds and determines that the expense of the said construction, re-location, alteration and abolition of the crossings mentioned, including the compensation for damages to property taken, injured and destroyed, shall be borne and paid by the parties interested in the following proportion:

"Ten per cent of the said amount, by the Wilkes-Barre Railway Company;

"Eighty-one per cent by the Wilkes-Barre Connecting Railway Company;

"Eight per cent by the Central Railroad Company of New Jersey;

"One per cent by the borough of Miners Mills.

"The Commission is also of the opinion, and hereby orders and directs, that the Wilkes-Barre Connecting Railway Company shall proceed to do the whole of the work connected with the construction of the proposed viaduct in accordance with the plans and specifications approved by the Commission and now on file at its office in the city of Harrisburg, and shall report monthly to the Chief of the Bureau of Engineering of the Public Service Commission the progress made in the construction of the said improvement.

Order.

"The matter of the existing grade crossings of the facilities of the Wilkes-Barre Railway Company and of Mill Street over the tracks of the Central Railroad Company of New Jersey in Miners Mills borough having been brought to the attention of the Commission by a petition of the Wilkes-Barre Connecting Railroad Company, and the hearings held thereon, and the Commission having, after investigation and hearings, made a finding and determination in relation to said crossings and having adopted plans and specifications for the abolition of said crossings and the construction of a new crossing over the facilities of the said Central Railroad Company of New Jersey and the Wilkes-Barre Connecting Railroad, all of which more fully appears in the aforesaid finding and determination which is hereby referred to and made a part of this order:

"NOW, to-wit, January 22nd, 1915, IT IS ORDERED;

"FIRST. That the Wilkes-Barre Connecting Railroad Company proceed forthwith to construct the viaduct over the facilities of the Central Railroad Company of New Jersey and the Wilkes-Barre Connecting Railroad Company, in accordance with the plans and specifications referred to in said finding and determination and now on file with the Chief of the Bureau of Engineering of the Public Service Commission of the Commonwealth of Pennsylvania, a copy of which plans and specifications are hereto attached,

"SECOND. That the Wilkes-Barre Connecting Railroad Company report monthly to the Chief of the Bureau of Engineering of the Public Service Commission the progress made in the construction of the said viaduct.

"THIRD. That the parcels or pieces of land mentioned in said finding and determination be and the same hereby are taken for the construction of said improvement and the amount set forth in said finding and determination are hereby ascertained and determined as damages for said property taken, injured or destroyed.

"FOURTH. That the Wilkes-Barre Railway Company pay 10% of the total cost, including the damages awarded to the owners of adjacent property;

"FIFTH. That the Wilkes-Barre Connecting Railroad Company pay 81% of the total cost, including the damages awarded to the owners of adjacent property;

"SIXTH. That the Central Railroad Company of New Jersey pay 8% of the total cost, including the damages awarded to the owners of adjacent property;

"SEVENTH. That the borough of Miners Mills pay 1% of the total cost, including the damages awarded to the owners of adjacent property;

"EIGHTH. That each of the parties interested, assessed with a portion of the cost of said improvement, shall pay its proportion of the amounts ascertained and determined by the Commission, or by the proper authorities on appeal, as damages for property taken, injured or destroyed, to the parties entitled thereto, and the balance of the total cost to the Wilkes-Barre Connecting Railroad Company, in conformity with any contracts of the said railroad company providing for said construction and upon monthly estimates furnished by the engineer of the Wilkes-Barre Connecting Railroad Company and approved by the Chief of the Bureau of Engineering of the Public Service Commission.

"NINTH. That the existing grade crossings of the Wilkes-Barre Railway Company and of Mill Street over the tracks and facilities of the Central Railway Company of New Jersey and the Wilkes-Barre Connecting Railroad Company shall be abolished at such time during the construction of the above mentioned improvement as shall seem best for the safety of the public, in the opinion of the Public Service Commission.

"BY THE COMMISSION:

"(Signed) Sam'l W. Pennypacker,
"Chairman."

Attest:

A. B. Millar,
Secretary.

(Seal)

DELAWARE, LACKAWANNA AND WESTERN RAILROAD.

Clarks Summit to Hallstead.

Clarks Summit borough until recently was a village in South Abington Township, Lackawanna County, on the main line of the Delaware, Lackawanna and Western Railroad, about 12 miles west from the city of Scranton. The city of Scranton is located in the valley of the Lackawanna River. Clarks Summit is so called because it is located at the summit of the range of hills forming the western boundary of the Lackawanna Valley and hence it is the summit in the grade of the railroad. The population of South Abington Township including the then village of Clarks Summit was 1,987 only. Since then the village has experienced a rapid growth due partly to the construction of a trolley line connecting with Scranton.

Hallstead borough, population 1,538 in 1910, is in Susquehanna County on the Susquehanna River 2.5 miles south of the State line between New York and Pennsylvania. It is also on the main line of the Delaware, Lackawanna and Western Railroad.

The distance by railroad between Clarks Summit and Hallstead by the line that existed before the changes described in this report were undertaken, was 42.6 miles.

The old line extended northwesterly from Clarks Summit down the valley of Ackerly Creek to the south branch of Tunkhannock Creek at LaPlume and thence across country to Tunkhannock Creek at Nicholson and thence up a tributary known as Martins Creek to near New Milford and thence down the valley of Salt Lick Creek to Hallstead. In this distance there were maintained 11 passenger stations and the line passed through 9 boroughs, 8 townships and also served one adjoining borough and four adjoining townships, having all told a total population in 1910, of 16,361. The location of the stations and the said boroughs and townships and the population of each is shown in the following table:

From Hallstead west the maximum grade is 12 feet per mile into Binghamton, N. Y.

Passenger Station.	Location of Railroad.				Population in adjoining townships.
	Borough!	Population.	Township.	Population.	
Lackawanna County.					
1—Clarks Summit,	Clarks Summit, ..		So. Abington, ..	1,987	
2—Glenburn,	Glenburn,	319			Waverly B., ... 515
3—Dalton,	Dalton,	767			W. Abington, .. 216
					N. Abington, .. 319
4—LaPlume,	LaPlume,	258			
5—Factoryville,	Factoryville, ...	759			Benton, 807
Wyoming County.					
6—Nicholson	Nicholson,	852	Clinton,	454	
			{ Nicholson, ... }	720	
			{ Nicholson, ... }		
Susquehanna County.					
7—Foster,	Hopbottom	364	{ Lathrop, }	614	
			{ Lathrop, }		
			Lenox,	1,109	
8—Kingsley,			{ Harford, }	1,230	Brooklyn, 954
9—Alford,			{ Harford, }		
10—New Milford,	New Milford, ..	654	{ New Milford, .. }	1,110	
			{ New Milford, .. }		
			Great Bend, ...	815	
11—Hallstead,	Hallstead,	1,538			
		5,511		8,039	2,811
Borough population,					5,511
Township population,					8,039
					2,811
					10,850
Total population, in 1910,					16,361

It may be well to note the elevations along the line of this old railroad location. At the city of Scranton over the Lackawanna River the elevation of the railroad was 736.1 feet above sea level. At Clarks Summit 1,242 feet or an ascent of 506 feet. The elevation of the tracks over the south branch of Tunkhannock Creek at LaPlume was 885.5 feet, or a descent of 353 feet, equivalent to 74 feet per mile. The ascending grade to Clarks Summit from Scranton was equivalent to 75 feet per mile. In crossing the country to Nicholson, the elevation of the summit reached was equivalent to an ascent of 30 feet per mile and the descending grade into Nicholson to 74 feet per mile. The elevation of the tracks at Tunkhannock Creek in Nicholson was 754.5 feet.

Passing up Martins Creek Valley to the summit near New Milford, an elevation was obtained of 1,166.8 feet or an ascent of 412. feet equivalent to 36 feet per mile. From this summit near New Milford down Salt Lick Creek valley to Hallstead, a descent of 295 feet was made to elevation 872 at Hallstead, equivalent to a grade of 60 feet per mile.

When the railroad was originally built, the line was selected and built along a route cheapest to construct and hence little attention was paid to grades and curves. The traffic at that time was light and did not warrant the larger expenditure required to build a perfect railroad. This was between the years 1850 and 1853. It was known then as the Leggits Gap Railroad because the route from Scranton westerly was up Leggits Run Valley and through Leggits Gap between Scranton and Clarks Summit.

In the year 1911, when the through passenger and freight traffic on this main line between Buffalo and New York City, and particularly between Binghampton, N. Y. and Scranton, Pa., had become so enormous as to make necessary, from a standpoint of economy, a reduction in the grades and in the curves between Binghampton and Scranton, there were on this part of the railroad, 14 grade crossings in Lackawanna County, 6 in Wyoming County and 17 in Susquehanna County, from Clark's Summit to Hallstead inclusive. Their location is shown in the following tabular statement:

Grade Crossing on Old Line.—1911.

County.	Municipality.	No. of Grade Crossings.	
LACKAWANNA,	S. Abington Township,	4	(Now in Clarks Summit Boro.)
	Glenburn Borough,	5	
	Dalton Borough,	3	
	LaPlume Borough,	2	
			14
WYOMING,	Factoryville Borough,	2	
	Clinton Township,	2	
	Nicholson Township,	1	
	Nicholson Borough,	1	
			6
SUSQUEHANNA,	Lathrup Township,	2	
	Hopbottom Borough,	3	
	Lenox Township,	2	
	Harford Township,	3	
	New Milford Township,	3	
	New Milford Borough,	2	
	Great Bend Township,	3	
	Hallstead Borough,	2	
Total grade crossings,			17
			37

Besides these crossings at grade of public highways of which 20 were within borough limits in 1911, there was a highway crossing beneath the railroad in LaPlume borough, in Factoryville borough, in Nicholson borough and in Harford Township and a highway over the railroad tracks in Clinton Township at the tunnel, making in all 42 highway crossings.

Early in the year 1911, the railroad company undertook the solution of one of the most expensive engineering projects consummated in the eastern section of the country, involved in the obviating of heavy grade, the elimination of sharp and reverse curves and the avoidance of grade crossings. Most of the distance between Clarks Summit and Hallstead where the contemplated changes were to be made is a mountainous district presenting natural difficulties to the construction of a railroad, the surmounting of which meant excessive expenditures of money, warranted only by the heavy through traffic and for this reason only. It can be readily seen that a total population of 16,000 people in 1910, tributary to the railroad from Clarks Summit to Hallstead, would not afford a revenue from its patronage sufficient to warrant any change

in the old railroad. In fact, the traffic there supported two local trains daily between these two stations; but the through passenger traffic and express and freight traffic between New York City and Buffalo and between Scranton and Buffalo and other important intermediate points did warrant the undertaking. It is also apparent that to straighten the line and to obviate heavy grades, the new route through a mountainous district must involve a departure from the valleys of the creek and the construction of numerous bridges and high viaducts and possibly the construction of tunnels, and consequently the new route would be expected to alter and materially change some of the existing facilities which have since 1850 affected the growth and development of the villages and towns along the old line, such for example as existing freight depots and passenger stations and siding facilities, more particularly if the project involved the abandonment of the old line of railroad and the old depots and stations after the new line was completed and put in operation. Hence this phase of the project is peculiarly interesting, and it may be stated, that where the 42.6 miles of railroad under discussion, a highway of traffic through a populous district that the attempt to abandon the old line might entirely fail of having been successful.

The said railroad company, by due and proper corporate action, under and by virtue of the laws of the Commonwealth of Pennsylvania, declared the necessity for a widening, straightening, enlarging and otherwise improving of the line extending between a point in the township of South Abington, Lackawanna County, near Clark's Summit, to a point in the township of Great Bend, Susquehanna County, near Hallstead. This action, as to that portion between Clarks Summit and New Milford, was taken in the year 1912, and between New Milford and Hallstead in the year 1913. The said company had acquired by purchase or condemnation most of the right of way necessary for the said improvement and had engaged in the construction work to a considerable extent, prior to the creation of the Public Service Commission. At that time, July 26th, 1913, the work of constructing the road bed for the said improvements had so far progressed that some of the tracks were being laid and it was necessary for the railroad company to ascertain and decide upon the location of its signals, sidings, depot and terminal facilities. There were, however, a number of crossings that required the approval of the Public Service Commission.

The Improvements.

Beginning at Clarks Summit borough where the tracks are straightened and the grade is lowered some 30 feet, the new route lies to the east of the old route and passes into Glenburn borough where at the new Glenburn station the tracks are about 2,000 feet east of the old tracks and about 100 feet higher; thence through a portion of Dalton borough, where at the new station the tracks are about 2,500 feet east of the old tracks and about 100 feet higher; thence through a portion of North Abington Township into the extreme edge of LaPlume borough, where at the new station the tracks are about 4,000 feet east of the old track and about 115 feet higher; thence through the western edge of Benton Township into Clinton Township at the extreme eastern edge, where at the new station the tracks are 8,300 feet distant from the old track and about 150 feet higher; thence into Nicholson Township, through the tunnel and over the Tunkhannock viaduct into Nicholson borough, where at the new station the tracks are 1,000 feet east of the old track and 193 feet higher; thence through a narrow strip of Nicholson Township and a small stretch of Lenox Township into Lathrop Township to Foster Station in Hop-

bottom borough, where at the new station the tracks are 1,200 feet distant from the old track and about 125 feet higher; thence through a small portion of Lathrop and Lenox townships and Harford township into Brooklyn Township to the new Kingsley station, where the new tracks are about 2,300 feet west of the old tracks and about 75 feet higher, the crossing over the valley of Martins Creek from the east to the west sides being by means of the Martins Creek viaduct; thence continuing through Brooklyn Township to the new Alford station where the tracks are 800 feet west of the old tracks and about 50 feet higher; thence through Brooklyn Township and New Milford Township to New Milford borough, where at the old station, which is to remain, the new and the old routes come together, but the new tracks are two feet higher; thence through the New Milford and Great Bend townships, where the new tracks lie west of the old ones, and where the old tracks will be used for west bound traffic, to Hallstead borough at the new station, whose location is about the same as the old, but the new tracks are 20 feet higher.

This new route between Clarks Summit and Hallstead is 3.6 miles shorter than the old line, and the running time of trains will be cut between 20 and 30 minutes between each point.

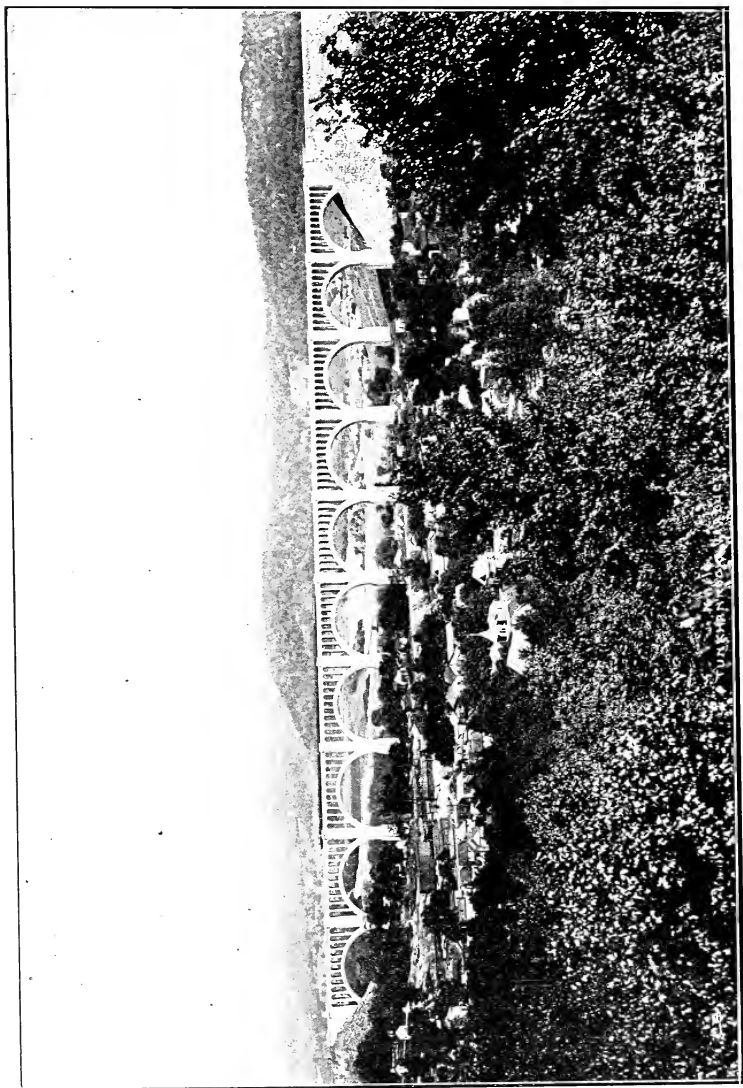
The summit of the depressed tracks through Clarks Summit borough have an elevation of 1,212.5 feet above sea level; thence the grade will descend at the rate of 36.27 feet per mile to the tunnel near Nicholson and at the Tunkhannock viaduct in Nicholson borough the elevation is 947 feet or 240 feet above the creek beneath; thence the grade ascends at the rate of 12.5 feet per mile to the New Milford summit at elevation 1,140.3; and thence the grade descends into Hallstead borough at the rate of 32.15 feet per mile. The maximum grade on the old line was 1.23%, whereas on the new line it is but 0.68%. The total curvature on the old line was 3,970 degrees, whereas on the new line it is 1,570 degrees only. The maximum degree of curvature on the old line was 7 degrees, whereas on the new line it is 3 degrees and compensated. The grade from Clarks Summit to New Milford summit has been reduced from 71 feet in a mile to 36 and 12.5 feet in a mile, and from New Milford summit to Hallstead it has been reduced from 60 feet in a mile to 32 feet in a mile.

The location of the new stations, the distance between the new and the old tracks and the difference in location is shown in the following tabular statement:

Passenger Stations.

Passenger Stations.		New Location of Railroad, etc.		
Name.	New or Old.	Distance between old and new station.	Difference in elevation of new tracks.	Location.
Lackawanna County.				
1—Clark's Summit,	Old station..	Feet. 0	Feet. 301 lower,...	Clark's Summit Borough.
2—Glenburn,	New station,	2,000	190 higher,...	Glenburn Borough.
3—Dalton,	New station,	2,500	100 higher,...	Dalton Borough.
4—LaPlume,	New station,	4,000	115 higher,...	North Abington Township. LaPlume Borough. Benton Township.
Wyoming County.				
5—Factoryville,	New station,	8,300	150 higher,...	Clinton Township. Nicholson Township.
6—Nicholson,	New station,	1,000	193 higher,...	Nicholson Borough. Nicholson Township.
Susquehanna County.				
7—Foster,	New station.	1,200	125 higher,...	Lenox Township. Lathrop Township. Hopbottom Borough. Lathrop Township. Lenox Township. Harford Township.
8—Kingsley,	New station,	2,300	75 higher,...	Brooklyn Township.
9—Alford,	New station,	800	50 higher,...	Brooklyn Township. New Milford Township.
10—New Milford	Old station,.	0	2 higher,...	New Milford Borough. New Milford Township. Great Bend Township.
11—Hallstead,	New station,	0	20 higher,...	Hallstead Borough.





Tunkhannock Viaduct at Nicholson Borough, Looking East.

Along the new route 42 public highways are crossed, at 19 of which the highway is bridged over the railroad, and at 22 of which the highway is carried under the railroad, and at one place an old grade crossing is maintained on the old line as a grade crossing because it is impracticable to avoid it. This is in New Milford township about a mile north of New Milford borough where the two new tracks are laid a few hundred feet west of and paralleling the two old tracks. The new tracks are elevated sufficiently so that the township road which crosses the old tracks at grade is carried underneath the new tracks. To separate the grades of the old tracks and the township road, on account of drainage, would make it necessary to build a viaduct of great length over Salt Lick Creek and the old track and estimated to cost at current prices about \$50,000. The township road is travelled on an average by 6 or 8 teams per day. The 41 crossings where the grades are separated are about equally divided, 20 of them being in the townships and 21 of them being in the borough. In the following table the location of these crossings is shown:

County.	Highway.		Location.	
	over.	under.	Borough.	Township.
Lackawanna County.	4	.....	Clarks Summit.	
	1	.....	Glenburn.	
	1	.....	Dalton.	
		.....	.....	North Abington.
	1	.....	LaPlume.	
	2	.....	.....	Benton.
Wyoming County.				
	2	(at tunnel)	.....	Clinton.
	1	.....	Nicholson.	Nicholson.
Susquehanna County.				
	1	.....	.....	Lathrup.
	1	.....	Hopbottom.	
		.....	.....	Harford.
	1	.....	.....	Brooklyn.
	2	.....	.....	New Milford.
	1	.....	New Milford	
	1	.....	Hallstead.	Great Bend.
	19	22		

The improvement has eliminated 36 grade crossings and in their place substituted 41 overhead and underneath crossings. The cost for the masonry work at these new crossings including the steel work amounted to \$681,000 and the cost for constructing the approaches including incidental damages amounted to about \$419,000, making a total cost of approximately \$900,000. Two of the crossing are carried over a tunnel, and two of them are spanned by a viaduct, so that the average cost for the remaining 37 separated crossings is \$24,300.

Types of Bridges.

Tunkhannock Viaduct—The Tunkhannock viaduct, so called because it is built across the valley and over Tunkhannock Creek in the borough of Nicholson, Wyoming County, is the largest re-inforced concrete bridge in the world. It is a two track structure, 2,375 feet long and stands 240 feet above the creek bed and 300 feet above bed-rock foundations. The accompanying photo-

graph, shows the massive proportions, particularly when one discerns the railroad train shown on the viaduct. The bridge consists of 10 spans of 180 feet each and two spans of 100 feet each. The large arches are surmounted by small superimposed lateral arches upon which the solid concrete surface of the viaduct is carried. In its construction, 167,000 cubic yards of concrete and 1,140 tons of re-inforcing steel were used. The cost of the structure was approximately \$1,500,000. The work was begun in the spring of 1911, and completed early in the year 1916.

Martins Creek Viaduct—Martins Creek viaduct is located partly in Harford Township and partly in Brooklyn Township, Susquehanna County, about one mile south of Kingsley Station. The bridge is a three track structure, 1,600 feet long and 150 feet above the bed of the creek. It consists of 11 re-inforced concrete spans, 7 of which are 150 feet in length, 2 of 100 feet in length, and 2 of 50 feet length. In its construction, 77,500 cubic yards of concrete were used, and 1,600,000 lbs. of re-inforcing steel. The cost was about \$800,000. Its pleasing architecture may be noted by reference to the accompanying photograph.

Railroad Bridges—The accompanying photograph of the Waverly Road arch at Dalton is typical of the under highway arched crossings, the spans of which range from 24 to 34 feet. This Dalton arch is a 34 foot semi-circular span.

The accompanying photograph of the Creamery Road bridge New Milford, shows a railroad bridge over a highway similar to numerous other flat top under crossings, some of which are of slab and others of beam construction. The span of the structure shown in the photograph is 20 feet and has a vertical clearance of 12 feet only. The borough council consented to these dimensions. The Public Service Commission did not then have jurisdiction. The span of all other structures of this kind along the line is 24 feet with a vertical clearance of 14 feet. Within one half a mile of this New Milford underpass, and also within said borough, there is a highway over crossing. The reason that a vertical clearance of 12 feet was agreed to was on account of drainage. 300 feet distant and at a slightly lower level is Salt Lick Creek.

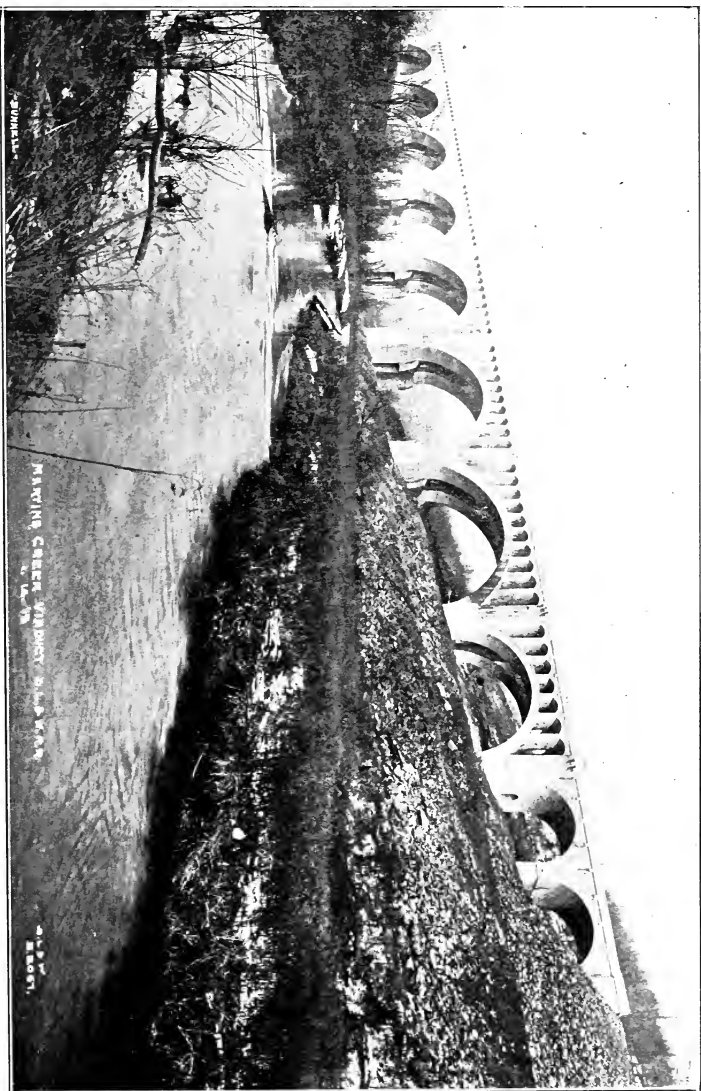
The accompanying photograph of the Church Street bridge in Hallstead Borough shows another form of slab construction for a railroad bridge over a highway. Church Street is a borough highway. The total width of the bridge or street between the abutments is 50 feet. The sidewalks are 8.5 feet in the clear and the two roadways on both sides of the centre piers are 14 feet in the clear and the vertical clearance is 14 feet.

Highway Bridges—The accompanying photograph of the Gilmore Road bridge in Benton Township, showing the Crissman Road arch in the back ground is typical of some of the overhead highway arches along the new line. The 60 foot span provides for a 4 track roadway and the width of the bridge for highway traffic is 24 feet in the clear as are all of the highway bridges along the route. The floor is of slab construction and the wearing surface is macadamized.

The accompanying photograph of the Alford Road bridge in Brooklyn Township is typical of some other overhead highway arches along the new line. The span of 60 feet provides for a 4 track roadway. The arch is elliptical and has 10 foot 9 inch rise and 1 foot 6 inch crown thickness.

The Tunnel.

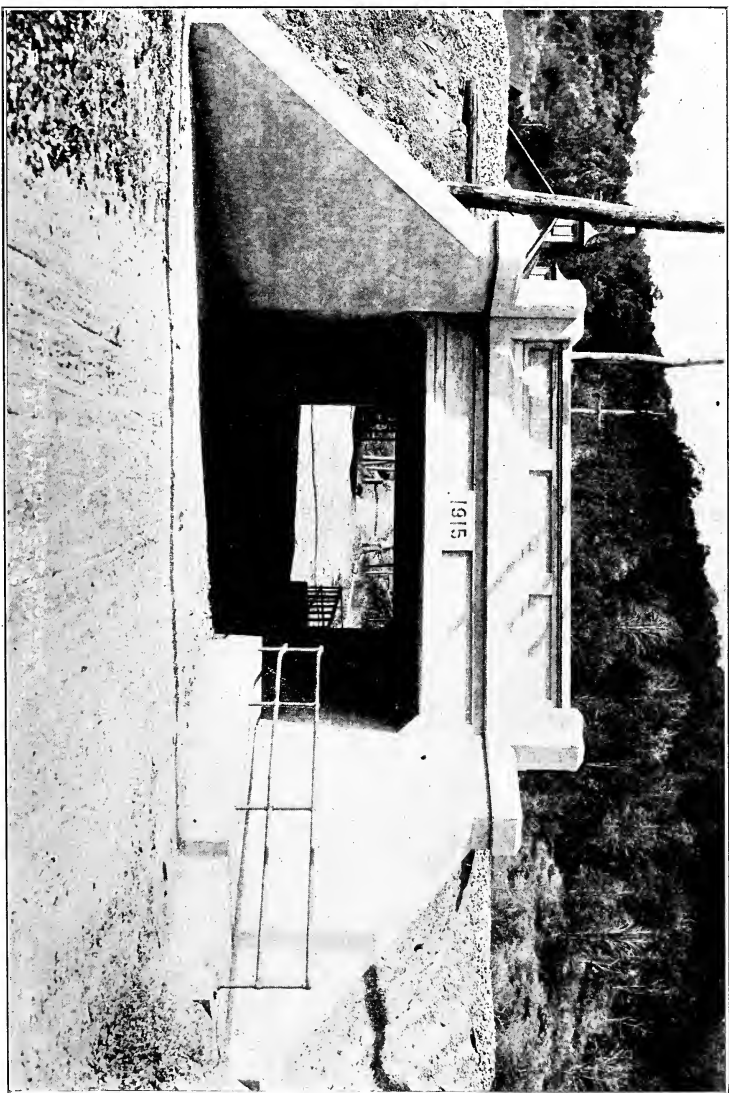
The tunnel is located in Nicholson Township, Wyoming County about one mile south of the Tunkhannock viaduct. It is a two track structure built in rock, faced with concrete and lined with brick, 3,200 feet long with two air



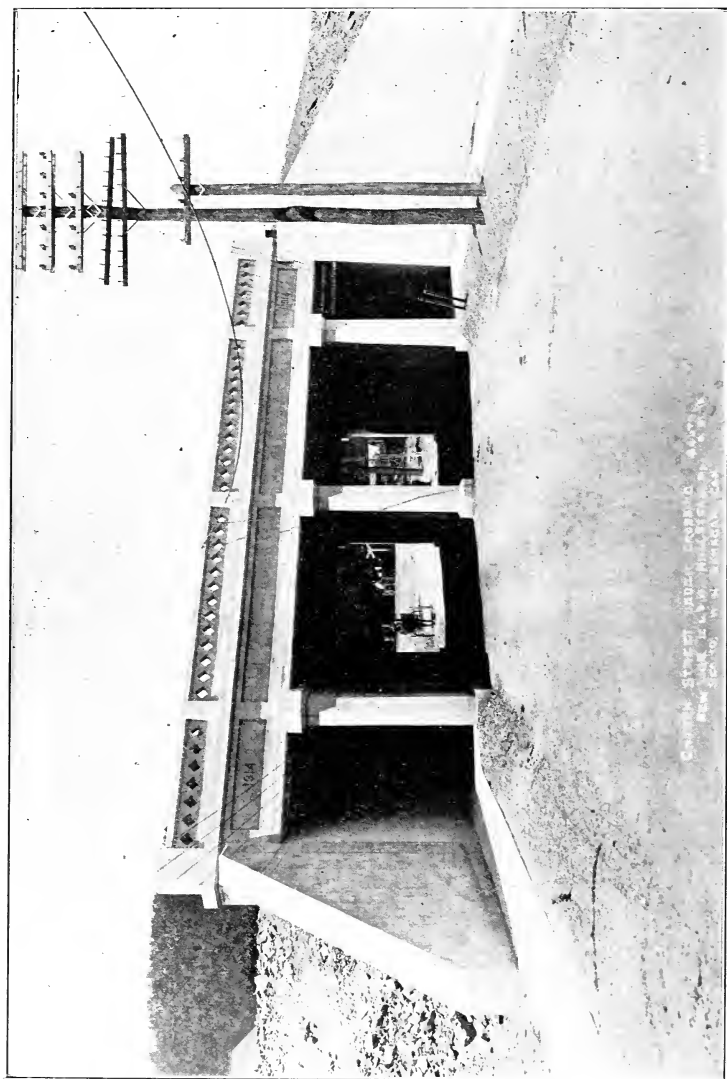
Martins Creek Viaduct, Looking North up Stream.



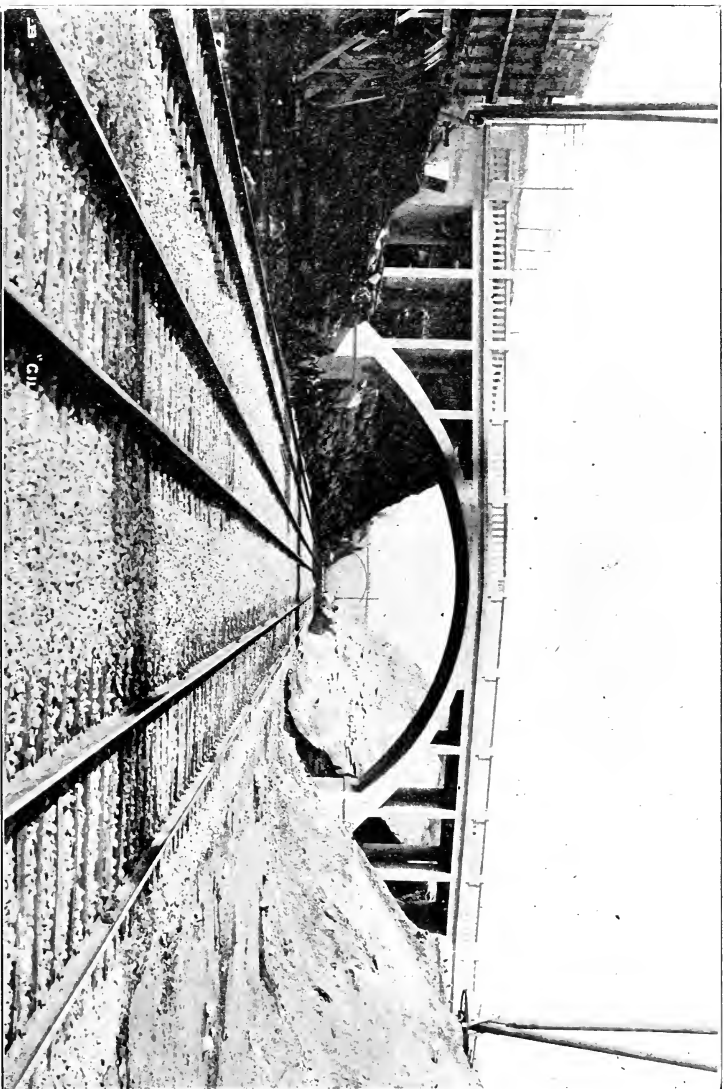
Dalton, Waverly Road Arch, Looking East.



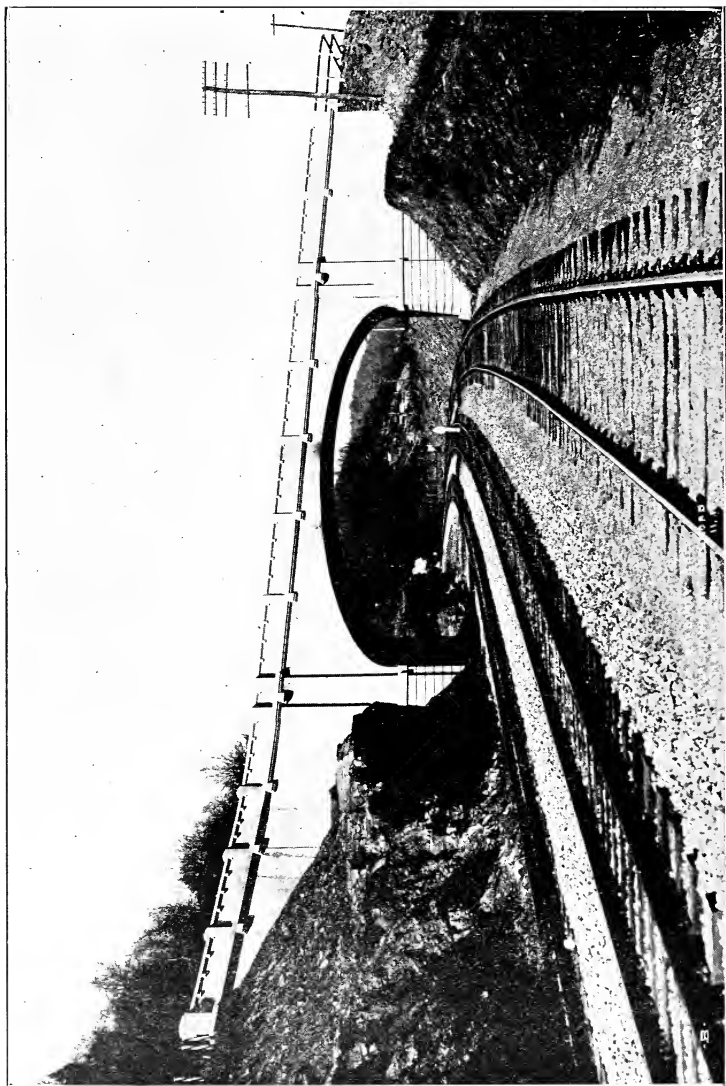
New Milford, Creamery Road Bridge, Looking West.



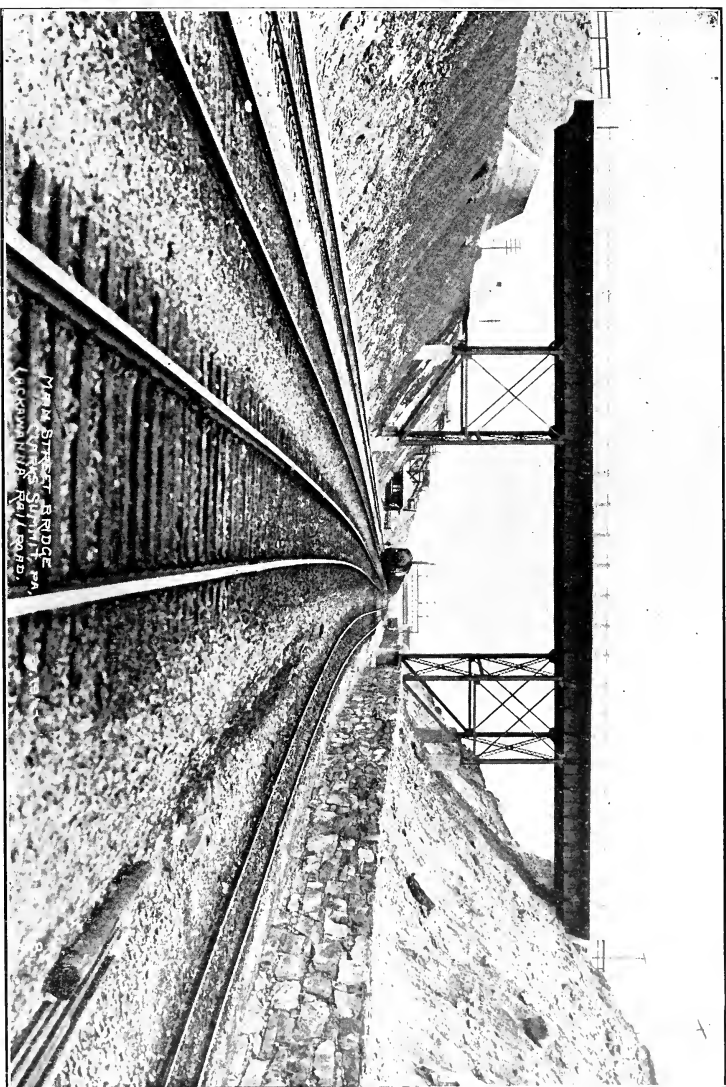
Hallstead, Church Street Bridge, Looking West.



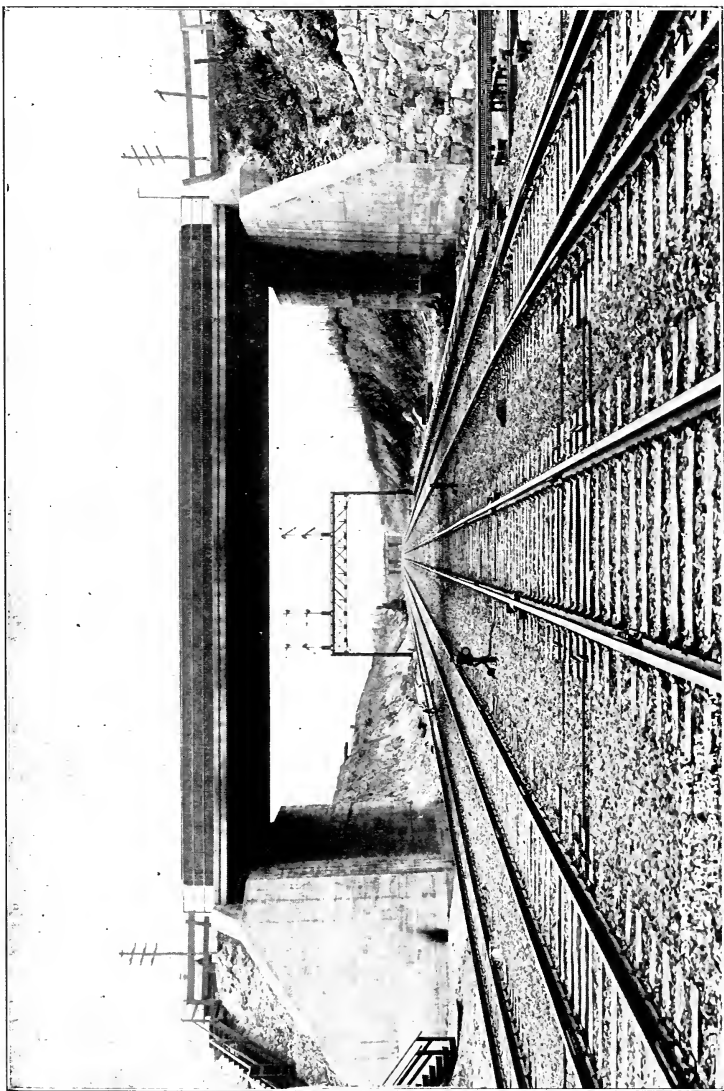
Benton Township, Gilmore Road Bridge, Looking North. Crissman Road Arch in the Background.



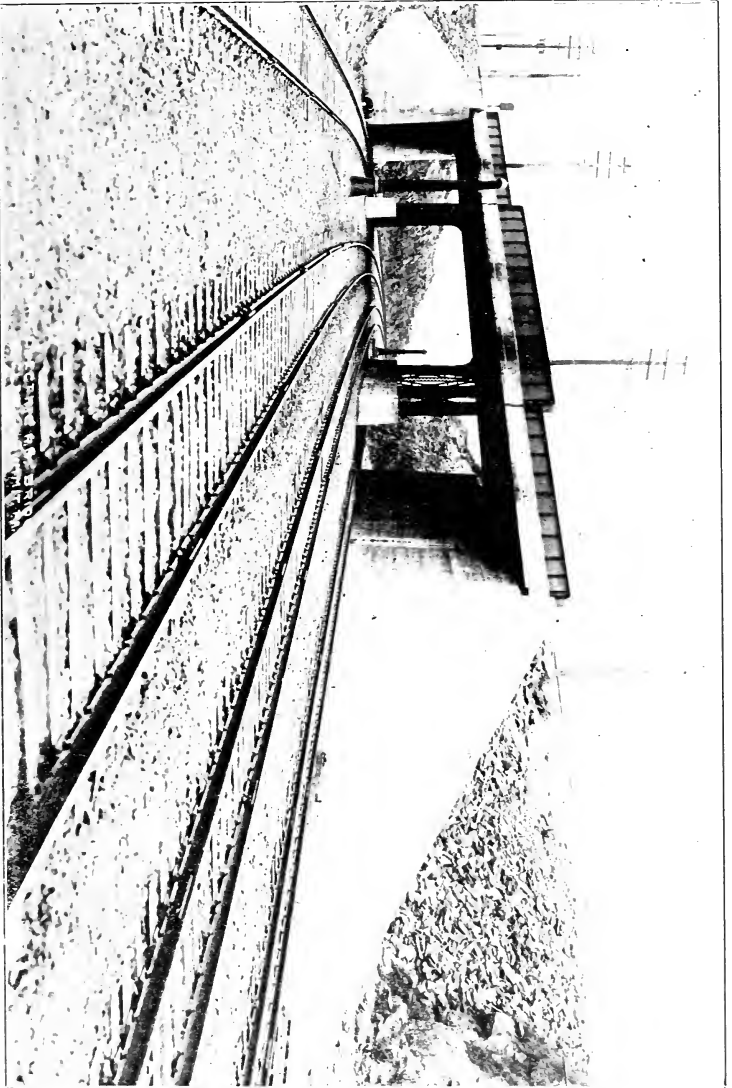
Brooklyn Township, Alford Road Bridge, Looking North.



Clarks Summit, Main Street Bridge, Looking North.



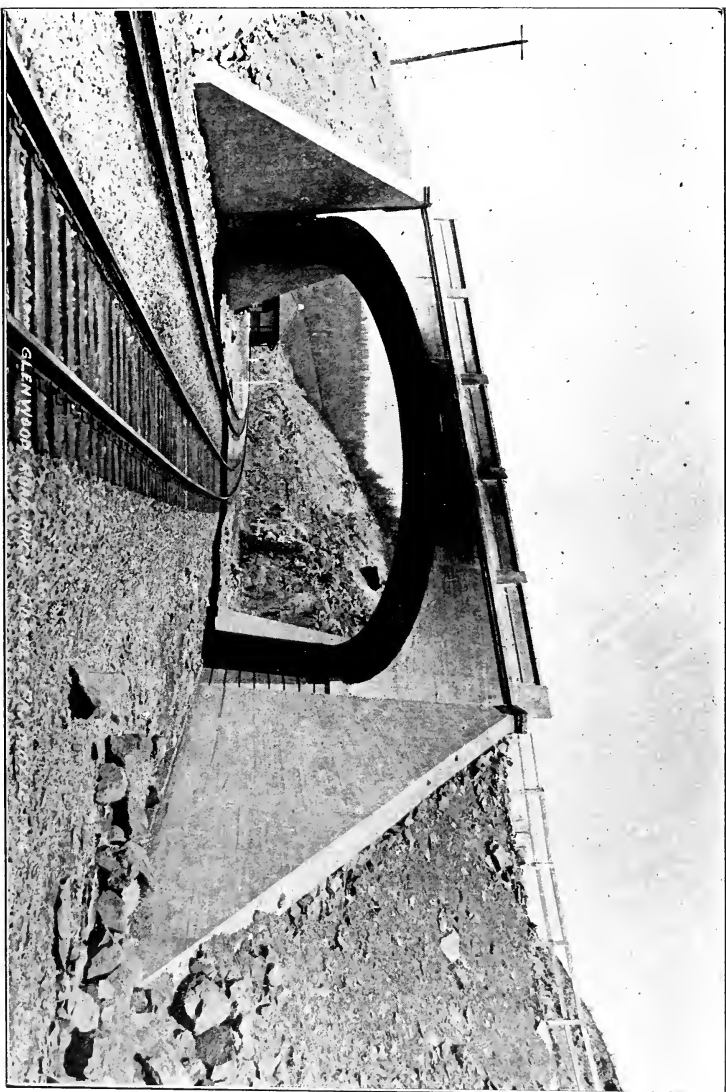
Clarks Summit, Depot Street Bridge, Looking North.



Charles Summit, State Highway Bridge, Looking North.



Hop Bottom, Looking North, Showing Old and New Tracks.



Hop Bottom, Glenwood Road Bridge and Foster Station, Looking North.

shafts. It is 30 feet wide at the track level, the arch is semi-circular, 15 feet radius, the springing line being 8 feet 8 inches above the level of the base of the rails. The tracks are laid on 13 foot centres, the centre line of each track being 8 feet 6 inches distant from the nearest side wall. This provides a vertical clearance of 20 feet above the top of the outside rail of each track.

Total Cost of Improvements:

The amount of earth removed in making the improvements reached a total of 5,525,000 cubic yards, the rock excavation reached a total of 7,647,000 cubic yards, and 300,000 cubic yards of concrete were used in the bridges, viaducts and culverts, also 4,720,000 pounds of re-inforcing steel. The total cost of the project, including stations and equipment, damages and legal expenses, was approximately \$12,500,000, for 39 miles of new railroad, equivalent to a cost of \$320,513 per mile.

Crossings Considered by the Commission.

In Clarks Summit—This borough although a small community now has great expectations of growth. The railroad company by agreement with the town council erected three highway bridges over its new right of way and tracks. They are shown in the accompanying photographs. The first photograph is a view looking north of the Main Street bridge and the old passenger station roof may be seen in the background at the left at the elevation where it is to remain. A platform on the level of the tracks 30 feet below is now constructed and steps lead up to the station. The baggage is taken up on an incline plane operated electrically. It will be noted that the bridge is a steel girder, deck type, supported on steel columns with its ends resting on concrete abutments. In the back ground, the Depot Street bridge may be seen.

The second photograph shows the Depot Street bridge, a thru steel girder structure of the type used where spans and clearances prohibit the use of concrete. The I-beam floor is encased in concrete. The vertical clearance of all bridges over the railroads is nowhere near less than 22 feet above the top of the rail. In the back ground may be seen the city highway bridge.

The third photograph shows the state highway bridge over the railroad. Because of the length of the span due to the oblique crossing, the thru steel girder, with I-beams encased in concrete were supported by steel columns as shown in the photograph.

In spite of the fact that these three bridges are not far apart, the borough petitioned the Public Service Commission for the construction of a fourth highway bridge. The population now is about 1,700. Owing to proximity to Scranton, a very much larger population is anticipated within a few years and hence the local authorities have deemed it inexpedient to sanction the closing up of any highway laid out and used across the right of way and track of the railroad company. Knapp Road distant a few hundred feet south from Main street is alleged by the petitioners to be such a highway. At the close of the year, covered by this report, a conclusion had not been reached by the Commission.

In Hopbottom—Nearly all of the borough of Hopbottom is shown in the first of the two accompanying photographs. The first photograph looking north shows the new tracks high above the town and the old tracks, and it also shows the Glenwood Road arch highway bridge over the new tracks. This bridge and the approach to it was made the subject of a petition to the Public Service Commission. The borough of Hopbottom complained that it would be irretrievably

damaged for all time by reason of the abandonment of the old road station and freight depot which were on a level and in the heart of the village and about which the community had settled and the substitution therefor of the new tracks and station high above the town and that as part compensation for such damages the railroad company should widen, straighten and otherwise improve the public highway by relocating the same so as to provide a minimum grade on the approach to the new station and bridge over the tracks and pay all of the costs and expenses incident thereto. This the railroad company declined to do, but it has constructed a switch-back connection, starting from the new tracks between Nicholson and Foster and descending along the slope of the hillside to connect with the old tracks at the lower level into Hopbottom. By means of this connection the company purposes to maintain and use the existing freight depot at its old level in Hopbottom and thence via the old tracks or track at the old level transport freight in and out of Nicholson as well as Hopbottom. The distance between these towns is about 5.4 miles, and along this length of the old road including the boroughs there are 6 grade crossings.

The second photograph shows the Glenwood Road bridge and in the background the new Foster station at Hopbottom constructed in conformity with the plans approved by the Public Service Commission.

Clinton:

In Benton Township—The Gilmore Road crossing in Benton Township illustrated by an accompanying photograph was considered by the Public Service Commission and approved.

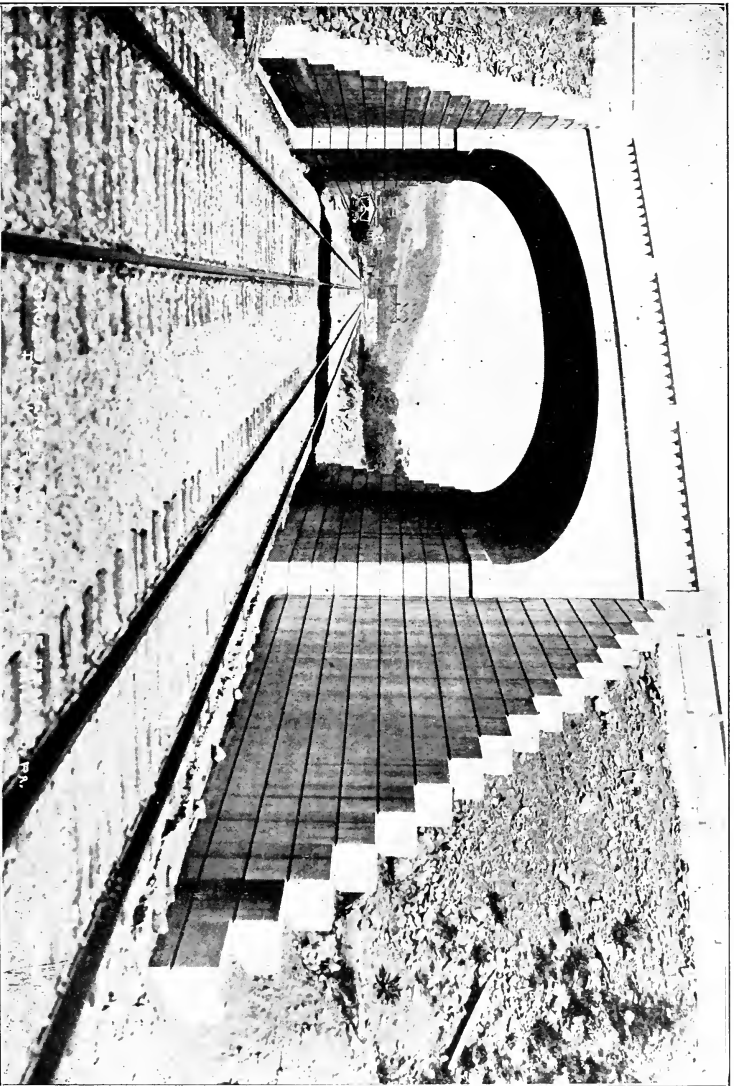
In Clinton Township—The vacation of one highway and the construction of a highway beneath the railroad at the new Factoryville station in Clinton Township, and particularly the matter of the location of the new station a mile and a half distant from the old station and the borough of Factoryville was made the subject of a complaint to the Commission. The underpass was constructed, also the new station, and the company at the end of the year covered by this report was considering the feasibility of building a siding for freight to connect with the borough and the old station.

In Nicholson Township—The matter of vacating one highway and of substituting therefore a re-located highway over the tunnel in Nicholson township came before the Public Service Commission. The matter was adjusted and at the expense of the railroad company.

In Lathrup Township—The construction of a township highway over the new tracks in Lathrup Township came before the Commission and received favorable action.

In New Milford Township—A very material relocation of the state highway and the construction of the new highway over the west bound tracks, being the old line, came before the Public Service Commission for approval. The accompanying photograph shows the new bridge as constructed in conformity with the plans approved.

In Great Bend Township—The abandonment of the so-called McKinney and Florence highway crossings in this township and the substitution therefor of a re-located state highway and bridge over the railroad came before the Public Service Commission and was the subject of protracted hearings and an order dated April 9, 1915.



New Milford Township, State Highway Bridge, Looking North.



Conclusions:

During the year the Scranton and Binghampton Street Railway was projected through the territory in question paralleling approximately the line of the old track and passing through and providing stations in all of the boroughs and at proper places in the township as far as Hopbottom. When this line is constructed, it is expected to operate on an hourly schedule and to carry baggage, express, and passengers. Such a service with the facilities which it is planned to provide will give to this territory advantages of transportation never before enjoyed and not possible within financial limitations for a steam railroad to provide. In consequence of this anticipated service, which appears to be assured, the citizens of the respective communities have been influenced to view with small concern the abandonment of the old steam railroad track.

CERTIFICATES OF VALUATION.

Section IV of Article III of the Public Service Company Law provides as follows:

"Application as hereinafter provided may be made by such public service companies to the Commission for a Certificate of Valuation, to the effect that the provisions of this section have been complied with as to any stocks, trust certificates, bonds, notes, or other evidences of indebtedness or other securities, issued after the passage of this act."

The same section also provides that it will be lawful for any public service company:

"To issue stocks, trust certificates, bonds, notes, or other evidences of indebtedness or other securities, or make any increase in the issue thereof, in the manner prescribed by law, for and only for money, labor done, or money or property actually received, in accordance with the requirements of the Constitution and the laws of the Commonwealth. All stocks, trust certificates, bonds, notes, or other evidences of indebtedness or other securities, issued in violation of this sub-section, and all fictitious increase of stock, trust certificates, bonds, notes, or other indebtedness or securities, shall be void."

THE NORTHERN CENTRAL RAILROAD.

The Northern Central Railroad Company made application to the Public Service Commission, approving the issuance of \$7,737,050 par value of said company's stock. The Commission instructed its Chief Engineer to make a physical valuation, and I examined and determined the fair valuation of certain extensions, improvements and additions to the property of the Northern Central Railway Company at various points from Northumberland County in Pennsylvania to the terminal facilities of said company along the harbor front in the city of Baltimore, Md., which extensions, improvements and additions were the evidence of money expended, labor done, and the property received for the capital expenditures for construction, equipment and real estate made

by said company during the eleven years ended December 31st, 1910, aggregating \$7,829,423.78 and which covers the expenditures of capital account for which said company asked a certificate of valuation.

Two divisions of the Northern Central Railway Company were involved in the valuation, namely the Susquehanna Division, which extends from Rockville, near Harrisburg, northerly beyond the Northumberland Yards; and the Baltimore Division which includes all of the other work and property considered.

The Susquehanna Division valuation comprised the Northumberland Yards and work incidental thereto, and changes and improvements on the main line between Sunbury and Rockville.

The Baltimore Division valuation comprised the consideration of three main groups of operations:

- 1—Those in the City of Baltimore.
- 2—Those between Baltimore and Enola.
- 3—The Enola Classification Yards and changes incidental thereto.

In the work of valuation, the items of expenditures as revealed by an examination of the books and accounts of the company made by the Commission's auditor, Mr. C. J. Joyce, Chief of the Bureau of Accounts and Statistics, were used as the basis for the field work. In the field and on the ground were sought and noted the evidence of said items of expenditure. It was impossible, with the time at our disposal, in forming an opinion as to the fair value of the work done and property acquired, to consider every fact, matter or thing which did or may have a bearing on such value. The conclusions were based, as more particularly appear in the detailed statements made to the Commission, upon considerations and data sufficiently comprehensive to make possible a fair and substantially correct determination.

No reproduction costs were figured, based on current prices for material, labor and property and no depreciation was figured or determined, since most of the work and the expenditures of money were for construction, extensions and improvements and additions of such character and of such recent date as to render depreciation immaterial, more especially since the property and facilities inspected are maintained in first class condition by the company out of revenue. I concluded that the investment under this high class of maintenance was being maintained in its integrity at 100% valuation and that while some deterioration must exist, that deterioration is not permitted to extend to the point of impairing service, and that when required, renewals are made out of earnings.

Susquehanna Division.

Northumberland Yards—The Auditor found items in the books and accounts, charged to the Northumberland Classification Yards, for construction, right of way and land, totalling \$603,258.39, this amount being 43.5% of the cost of the improvements, extensions and addition there up to the close of the year 1910. However, the yards were not completed until the year 1912. The examination which I made of the property and the improvements and facilities thereon at this time gave evidence of indebtedness having been incurred in the sum exceeding \$3,000,000. Therefore, there can be no question regarding the said item of \$603,258.39. A detailed statement of the property, facilities and improvements and the value thereof at the Northumberland Yards was prepared by me and submitted to the Commission.

On August 31st, 1913, an agreement was entered into between the Pennsylvania Railroad Company and the Northern Central Railway Company, covering the joint ownership, operation and maintenance of the Northumberland Yards. At that time the work of construction was practically completed. The said Classification Yards are in the county of Northumberland, and stretch along the Susquehanna River for about three miles and back therefrom in some places two-fifths of a mile. The Pennsylvania Railroad Company furnished in round numbers 56% of the funds necessary for the construction and the Northern Central Railway furnished the remaining 44%. Under said agreement there is a joint undivided ownership of the yards and for all additions, extensions, improvements and betterments, vested in the Pennsylvania Company to the extent of 56% and in the Central Company to the extent of 44%.

The operation of the yards is in charge of the Pennsylvania Railroad Company, each company paying for rental for use of the yards, excluding the transfer station, engine house, ash pits and coal wharf, such proportion of the following items as the number of cars handled for each of said parties shall bear to the total number of cars handled in the yards:

A—4% per annum upon the cost of the construction of the yards, fixed at \$2,703,413.65, May 31, 1913.

B—Interest upon the cost of additional facilities.

C—Interest upon the cost of maintenance.

D—Interest upon the cost of operation as follows:

For use of the transfer station and facilities the cost of which is fixed at \$116,896, such proportion as the number of tons handled at transfer station for each party shall bear to total number of tons handled there.

For the use of the engine house, ash pits and coal wharf, the cost being fixed at \$444,300 such proportion as the number of locomotives handled in or on said engine house, etc., for each party shall bear to the total number of locomotives handled therein or thereon.

Hence under said agreement of August 31st, 1913, the total cost of Northumberland Yards was fixed by the said three items as follows:

General Classification Yards,	\$2,703,413.65
Transfer Station, etc.,	116,896.00
Engine House and Facilities,	444,300.00
<hr/>	
Total,	\$3,264,609.65

I checked this amount and found it to be \$3,276,879.42.

The Auditor found that 43.5% of the cost of the Northumberland Yards to the end of 1910, was the sum of, \$603,258.39 charged on the books to the Central Company, representing a total cost at that time of \$1,386,800.

The Auditor found items of expenditures on the Susquehanna Division from Sunbury to Harrisburg for construction of passing sidings and track improvements and for rights of way and land incidental thereto, totalling \$204,322.16.

Main Track Improvements—I examined the localities where these expenditures on main track, passing sidings and improvements were made and found

ample evidence on the ground that the work was done, the materials were furnished and the land acquired, represented by said items and I reached the conclusion that the cost of these improvements as found by the Auditor on the books of the Company, represent the fair value at the present time of the same. A detailed statement was submitted to the Commission relative to this matter.

Discussion of Susquehanna Division—Relative to the Classification Yards, it should be noted that there are about 75 miles of tracks there. Valuing these, including rails, ties and laying as worth \$12,000 per mile, the value will correspond with the item for tracks found in the company's appraisal. A public highway had to be abandoned through the yards. In substitution therefor there was built a new highway 2.5 miles long. The construction was very difficult and expensive. The drainage was accomplished through the building of large and expensive culverts. After viewing the territory I determined that \$60,841.10 was a fair valuation of said public road, including incidentals. One may see similarly constructed highways in other parts of Pennsylvania which have cost more than \$25,000 per mile. An item of \$166,000 for yard culverts is substantially correct. In the yard there is one culvert 1,700 feet long that was built to care for the flow of a large natural water course relocated and reconstructed. This culvert alone might easily have cost two-thirds of the entire amount. The electric light and power plant item of \$210,000 represents value that can be seen on the ground. There is a complete power plant installation, modern in every respect, having a 500 K. W. capacity. Current is generated and furnished for lighting and power throughout the yards and shops. Steam is furnished for pumping water and air, heating, etc. The interlocking switches are electrically operated. The machinery in the shops is motor driven and altogether, the layout is new and first class and adapted for extensions. There is a complete fire alarm apparatus installation throughout the yards, shops and buildings. Telegraph and telephone line construction along the main tracks and throughout the yards has been provided. There is heavy overhead cable construction and some underground conduits. The poles are re-inforced concrete. The company has built and owns its own telephone wires and service. The yards are worked by telephone and the main exchange is in Sunbury. From this exchange to the north end of the yards the distance is four miles. The interlocking system includes two main towers, two push button machines at the Hump and the installation complete for the operation of signals that govern through movement of trains. The item of \$44,000 charged against this account appears to be small rather than large. The water works include a comprehensive system of collection at the source and distribution. The drinking water is separated and distinct from the commercial supply. The item of \$77,000 for water works represent value to be seen on the ground. The oil house item of \$21,000 includes the building and complete interior installation. It was not practicable to check up at this time the item of \$26,000 for moving main line tracks. Three miles of removal and relaying could easily have cost \$26,000 under the circumstances obtaining. For machinery and tools purchased and transferred there were items totalling \$65,000. Considering the extent of the shops and toe work performed in the yards, this total is not disproportionate. The total of \$156,000, for the vario s buildings as shown in detail, is a fair amount. There is ample evidence of such expenditure, item for item, that may be seen at the yards, and so with respect to the other items which go to make up the grand total as reported by the railway company of \$2,715,682.55.

The changes, extensions and improvements along the main line between Sunbury and Harrisburg involve the purchase of land, the building of middle

passing sidings, enlargement of bridges, moving of highways, construction of water tanks, stations, new towers and signal devices. Seven miles below Sunbury, at Fisher's Ferry, a middle passing siding was built 6,900 feet long in the year 1901. The old tracks were changed, crossings, switches and an interlocking tower were built, 85 lb. rails were used, as on all work, and the tracks were rock ballasted. At Herndon, 12 miles below Sunbury, about 900 feet of middle passing siding were built in 1900, this extension requiring the lengthening of a bridge. At Mahantongo, in 1900, a middle passing siding was extended at a point 21 miles below Sunbury. There is now a siding 8,100 feet long there. The work involved new track and changes in signals, towers, switches and cross-overs. West of Millersburg, 25 miles below Sunbury, in 1902, a double middle passing siding was built, a distance approximating one mile, and changes incident to this work, such as hereinbefore enumerated, were performed. East of Millersburg, 28 miles below Sunbury, extensions were made to cold storage sidings, involving about one mile of track. At Clark's Ferry, 27 miles below Sunbury, in 1901 and 1903, a middle siding was constructed. It is now 8,800 feet long. At Dauphin, 43 miles below Sunbury, in 1900, a double middle siding extension was constructed about half a mile in length. 44 miles below Sunbury, between Dauphin and Hecks, a very extensive piece of improvement was made. An old canal bed was filled in for a public highway and the old location of the highway was filled in, a retaining wall being required for this purpose, and upon the embankment an additional track was constructed about 4,300 feet in length. This work was done in 1902 and 1903. At Rockville, 47 miles below Sunbury, two outside passing sidings were constructed of a double length of about 200 feet. These various places were inspected and evidence was seen on the ground of the work done, corresponding to the expenditures made as shown on the books and of a present value fully equal to the amount of such charges.

Baltimore Division.

In the City of Baltimore—The Northern Central Railroad Company valuation of its harbor front property as submitted is \$1,764,783.86 of its Union Station property and improvements, \$391,859.73 and of its freight and other terminal properties, \$124,115.92 making a total appraisal of its properties in Baltimore of \$2,280,759.81.

The purchase for \$265,000 of 12.96 acres of land on the harbor front along Clinton Street included two wharf properties—one bought in May and the other in June 1909. The 8.2 acre tract is divided by Clinton Street. Between Clinton Street and the Port Warden line the lot is 902 feet long by 350 feet wide; on the other side of the street it is 130 feet wide by 204 feet long. There was a wharf on the property which was destroyed by fire since the purchase. The 4.75 acre tract lies between Clinton Street and the harbor line. It is 942 feet deep and has 220 feet street frontage. Maps of these parcels of land were seen and checked on the ground. The Auditor examined the deeds and verified the purchase price. This is true with respect to the other real estate and land items herein noted.

The lot upon which pier No. 6 now stands was purchased in 1900. It contains 10.68 acres. It is 935 feet deep with 498 feet frontage on the street. It cost \$138,000. A hotel and property on 12th Avenue 204 x 244 feet was purchased, costing \$38,000 and is a part of the terminal property. A 2 acre lot opposite pier No. 6 was purchased for the same purpose and cost \$40,000. On Clinton Street, extending to the harbor line, a coal wharf, bridge and trestle were purchased in 1903, this lot is 942 feet deep and has 175 feet frontage on the street. The property cost \$175,000. At Bond Street \$5,000 worth of land was purchased for additional yard facilities.

The Orangeville Engine House and Yards were not completed in 1910. They cost, all told, over \$500,000 as shown in a detailed statement submitted to the Commission. Of this cost, only \$72,000 has been included in the value certified. The engine house is a part of the Canton terminal improvements. Mr. Joyce found items of expenditures for additional tracks totalling \$95,000. Many miles of tracks have been laid here. The work is going on all the time in connection with the development of the terminal. Pier No. 6 is 808 feet long, 120 feet wide and is covered over with a shed and provided with modern facilities for handling bulk freight. The cost of construction of this pier was \$272,000 which cost is comparable with the cost of constructing piers of this kind with similar foundations. Grain elevator No. 3 was enlarged and improved, beginning in 1903 and ending 1908. 32 re-inforced concrete bins of modern construction were erected in 1908, costing \$242,000. The capacity is 1,000,000 bushels of grain. The old structure, which has been enlarged and improved to a capacity of 1,000,000 bushels had expended upon it in those years \$193,000. This elevator is located at the foot of 14th Street near the Ore Pier. It includes a power station and all of the appurtenances of an elevator. The structure could not be duplicated to-day at the same price. The Bond Street wharf, known as the Terminal Warehouse, was erected in 1900 at a cost of \$216,000. This includes the brick warehouse and the pier, bulk-heads and tracks.

At the Union Station the improvements cost considerably over \$1,000,000. Tracks were materially changed, the train yard was enlarged and altered and improved. Coming into the station from Mt. Royal, a mile of new track construction was completed. This involved heavy, expensive retaining walls, and the laying of two additional tracks. I examined the plans and made approximate estimates of quantities and determined that the full value for the expenditures found on the books by the Auditor, is evidenced on the ground.

With respect to the changes, additions and improvements to certain freight and other terminal properties of the Northern Central Railroad Company in the city of Baltimore, I examined the places, the land and the work done. The property is in the heart of the city and it comprises some of the most valuable sites in Baltimore. It is necessary to the present handling of the company's business and full values seem to have been received for the expenditures.

Main Line Improvements—The company's inventory and appraisal of main line improvements between Baltimore and Harrisburg for 11 years ending December 31st, 1910, amounts to \$114,214.97. With respect to these changes and improvements, I examined the plans, inspected the territory, noted the land purchased and the work done, as enumerated in detail in a statement submitted to the Commission, and determined that full values for the expenditures itemized may be seen on the ground. There were some minor items of expenditure which I did not investigate or appraise for lack of time and the total of these items for the Baltimore Division and for the Susquehanna Division amounted to about \$12,000.

Enola Yard and Connected Improvements—On April 12th, 1905, the Pennsylvania Railroad Company and the Northern Central Railroad Company entered into an agreement covering the joint, undivided ownership, operation and maintenance of the Enola Classification Yards, and covering certain trackage rights substantially as follows: The Pennsylvania Railroad Company was constructing a low grade route for the movement of its bulk freight between points on its main line, near the west end of Rockville Bridge, Perry County, and Atglen, Chester County, via the valley of the Susquehanna River to below Columbia and thence across Lancaster County. The Pennsylvania Company

and the Northern Central Company had jointly constructed a yard immediately south of the said Rockville Bridge, and opposite Harrisburg, known as the Enola Yards, for the accommodation of the traffic of their respective lines, the Pennsylvania Company having furnished 75% of the funds necessary therefor and the Northern Central Company the remaining 25% and whereas, to form a connection between the said low grade route and the said yard, the Pennsylvania Railroad Company desired trackage rights over and the use of the railway of the Northern Central Company from the south end of the Enola Yards to Wago Junction, York County, a distance of 18.9 miles. Hence it was agreed, relative to the Enola Yard ownership, to continue the joint and undivided ownership of the said yard and all additions and improvements thereto to the extent of 75% invested in the Pennsylvania Railroad Company and 25% in the Northern Central Company. It was agreed that the operation of the yard shall be in charge of the Pennsylvania Railroad Company, each party to pay as a rental, *first*, such proportion of the interest at 4% per annum upon the cost of the said Enola Yards, which was fixed on January 1st, 1905, at \$3,729,379, and upon the cost of all additions and improvements thereto, and *second*, such proportion of the cost of operation and maintenance thereof, including taxes and insurance, as the number of cars handled in the yard of each shall bear to the total number of cars handled therein.

The Northern Central Railway Company granted to the Pennsylvania Railroad Company the right to use the said 18.9 miles of Northern Central Railway and appurtenances upon the following terms; From time to time the Northern Central Railway Company will add to its railway and appurtenances to be used by the Pennsylvania Railroad Company, such additional tracks and other facilities as shall be necessary and proper; The Pennsylvania Railroad Company agreed to pay as rental for this use, a sum equivalent to that proportion of interest, at 4 per cent per annum, on \$3,199,182 which amount, for the purpose of the agreement, was fixed as the value on January 1, 1905, of that portion of the railway of the said Northern Central Railway Company between the south end of Enola Yard and Wago Junction and of the appurtenances available for the movement thereover of through traffic, which its car and engine mileage thereover shall bear to the whole car and engine mileage thereover, together with a further rental, at a like rate per annum; and computed on the same basis, on the cost of all additions, extensions, improvements and betterments which may from time to time be hereafter made and will pay a sum equivalent to its proper proportion, according to the said car and engine mileage basis, of the total cost and expenses of maintenance and operation of the said portion of said railway, taxes and cost of insurance to be included.

Additions and improvements for the years 1905 to 1910, inclusive, amounted to \$866,440.17. The construction items were for building additional tracks, changing the location of existing tracks, building telegraph lines, signals and interlocking devices and appurtenances to the 18.9 miles of railroad, including improvements at Wago Junction, Falls Yard, Lemoyne or Bridgeport Junction, bridges, culverts, drainage and water supply.

The total expenditures for the years 1900 and 1910 inclusive, for the Enola Classification Yards by both companies was \$4,787,538.40, one quarter of which being \$1,196,884.60, the share of the cost assumed by the Northern Central Company.

For the same term of years the expenses incurred by the Northern Central Railroad Company for improvements and connections between the Marysville Yard, Rockville bridge and the Enola Yard, amounted to \$275,393.49, making the total cost of the Enola Classification Yards and connected improvements, borne by the Northern Central Company upwards of \$5,500,000.

Prior to the construction of the Enola Classification Yards, which were put in operation the latter part of the year 1904, the Northern Central Railway Company tracks extended southerly along the west bank of the Susquehanna River from the Marysville Yard through Fairview, Wormleysburg, Bridgeport (now Lemoyne borough) New Cumberland, York Haven and Falls freight yard to Wago Junction; and thence on to Baltimore. The Pennsylvania Railroad crossed over the tracks of the Northern Central Railroad at the west end of the Rockville Bridge. The Cumberland Valley Railroad crossed at grade the tracks of the Northern Central Railroad at Bridgeport, there being a connection there for the Baltimore trains. The Philadelphia and Reading Railway crossed over and above the tracks of the Northern Central Railway. The Enola Yard project was a new undertaking. It involved the purchase of more than a square mile of area and the dedication to freight yard purposes of about 300 acres. Approximately 5,000,000 cubic yards of grading had to be done to prepare the ground for yard use. In this territory about 90 miles of tracks have been laid. Extensive freight car repair shops and machine shops, a power house, engine house, water station and other buildings and facilities have been built. The engine house has 52 stalls. A fair average cost of a stall is \$6,000. Also for a mile of rails and ties in place, \$12,000 is a fair estimate. The total cost of the Enola Yard, considering its greater extent and facilities, compared favorably with the total cost of the Northumberland Classification Yard and also with similar expenditures for the engine house and yard at Baltimore.

It was necessary to make changes, extensions and improvements at the Marysville Yard, to wall in and cover over Fishing Creek and to make alterations for bridges and change the location of highways between Marysville and Enola, costing all told upwards of \$250,000. It was also necessary to change the location of the main line between Wago Junction and Enola, in certain places, and to build two additional tracks to connect with the low grade line. Changes and improvements had to be made at the Falls Yards and at the intersections at Bridgeport. Land had to be acquired and its cost, including consequential damages, was necessarily large, because of the occupation of the property in the villages along the line and the existing high valuation placed upon the land at that time. The construction was also difficult, it being along a hillside in part and along the bank of the river. In this distance, 8 bridges and 15 culverts were required. There are evidences on the ground showing values fully equal to the amount charged on the books against the company.

The entire improvement provides a modern and necessary addition and extension to the facilities of the Northern Central Railway Company and the Pennsylvania Railroad Company. A town has been built at Enola for and is used as a place of residence by the employes of the said companies. This operation was carried on by the Manor Real Estate and Trust Company and does not appear on the books as any part of the Railroad Improvement, it having been incident to but separate from the accounts of the railroad companies.

Conclusions—Having made the physical examination of the additions, extensions and improvements to the property and facilities of the Northern Central Railway Company, as hereinbefore described, it is apparent that the finding was bound to be that the value of the work done and money expended in making said additions, extensions and improvements is in excess of the sum of money certified by the Railroad Company, namely \$7,829,423.78.

THE BETHLEHEM WATER COMPANY.

Upon application of the Bethlehem Water Company for a Certificate of Valuation, by direction of the Commission, the Bureau made a physical examination of the water works system. The intake, pumping station, lines of force mains, filtration plant, storage reservoir, stand pipe and distribution system of pipes in all portions of the crowded portions of said territory were visited and inspected; the detail construction plans and other plans of said water works system were examined; each parcel of land owned by the company was visited and appraised and the report and valuation of the plant by Stone and Webster, item by item as far as it could be done, was checked up on the ground, and in this work the reports of the certified accountant were also used.

This system is operated, so far as the purity of the water is concerned, under the supervision of the State Department of Health so long as this utility shall continue to supply water to the public under the operating rules of the State Commissioner of Health, the public has a practical guarantee that the water supplied is pure and wholesome. Such a relationship between the State and the Company adds very materially to the stability of the securities issued by the Water Company.

Charter Territory.

The charter territory of the Bethlehem Water Company includes all the land on both sides of the Lehigh River that has been built up and is now occupied by the city of South Bethlehem and adjacent municipalities. The said river rises to the north, in the mountains of Monroe County, and flows in a general southerly and easterly direction to the Delaware River, which it joins at Easton—twelve miles down stream from South Bethlehem City. Six miles up stream from the city of South Bethlehem is the city of Allentown, a manufacturing community of 51,913 population. In the territory around Allentown and above it in the Lehigh Valley, there are very extensive cement works and still farther up coal mining operations predominate. There is a canal operated by the Lehigh Coal and Navigation Company, extending from Manunka Chunk down the valley, by Allentown, the Bethlehems and Easton, terminating in the Delaware River near Philadelphia. Coal is the chief commodity of transportation given this canal.

In South Bethlehem is located the Bethlehem Steel Company plant, one of the largest in the world, and in this city and the towns round about, and for that matter in the entire valley there are many extensive and active industrial operations. Railroad facilities are adequate and there is no indication that the communities mentioned will not continue to grow and prosper.

South Bethlehem City lies along the south bank of the Lehigh River and opposite it is the borough of Bethlehem and the township of Hanover, which extends up stream to the City of Allentown—fourteenth ward—known as East Allentown. Back on the hills, contiguous to South Bethlehem City, is the borough of Fountain Hill, visibly a part of said city; so also with respect to the suburban settlement in Salisbury Township and with respect to the borough of Northampton Heights, which is adjacent to the eastern boundary of South Bethlehem City. Beyond in the township of Lower Saucon is the village of

Didier. All of these places are in the water company's territory. The present population in this thriving community is as follows:

South Bethlehem City,	23,000
Fountain Hill,	1,500
Northampton Heights,	1,200
West Bethlehem—Western portion of Bethlehem borough,	5,000
Rittersville village—Hanover Township,	800
East Allentown, 14th Ward, Allentown,	2,000
Didier village, Lower Saucon Township,	500
Salisbury Township,	250
	<hr/>
	34,250

Sources of Water Supply.

At a point just above South Bethlehem City the water company maintains an intake and derives from the river its source of supply to the public. This source is abundant for all future requirements. Even if the city should grow to be a community ten times its present size, there would still be an abundance of water in the river for the uses of the municipality. The Department of Health of the Commonwealth has undertaken to preserve the purity of the Lehigh River as a source of supply to the public and this circumstance assures to the Bethlehem Water Company not only an abundance of water, but a potable water. Hence, the expenditures by the Bethlehem Water Company, for furnishing water to the public will in the future be confined to the apparatus and works necessary to take the water out of the river, to render it clear and free from foreign ingredients, and to distribute it to the public. The situation is altogether to the advantage of the public and is another factor which adds to the stability of the investments of the utility.

Originally, spring water was collected on the top of the hills back of South Bethlehem and was supplied by gravity to a portion of the citizens residing in the vicinity. This property is now owned by the Bethlehem Water Company. The supply is very limited and it is utilized at present for furnishing a few dwellings only in the neighborhood. There will in the future be required the construction and operation of a high service district plant as a part of a system of the Bethlehem Water Company, but the water will be obtained from the Lehigh River and will have to be re-pumped out of the present distributing district into the future high service district. Some of the land now owned and held by the water company is being kept in reserve for this development.

The Water Works System.

The river intake, pumping machinery and the greater part of the force main lines were built in the years 1907-1908 in conformity with plans approved by the State Department of Health. The work was carefully executed and the facilities provided are ample for the present and future needs. The cost was made comparatively large because of the difficulties encountered in the way of excessive excavation of earth and rock; and of water encountered in building the tunnel, intake and foundations. The plant is in first class condition; and the power units are in duplicate and there is ample room for additional installation. The building is a substantial brick structure and there are adequate siding connections to the Lehigh Valley Railroad main line, which passes the pumping station layout.

The Water Works System.

The water is pumped to a twenty million gallon storage reservoir on the hill, located in Fountain Hill borough. This is used as a sedimentation basin and it is the summit of the water works system. Then the water flows by gravity through a modern filtration plant, built in 1907, and since extended and improved in conformity with plans approved by the State Department of Health; then to a filtered water reservoir of four million gallons capacity; and then under gravity pressure to the consumers. The two reservoirs and filter plant are joined and compactly arranged. The company owns other land on the hill in anticipation of future requirements and in this way has protected itself against excessive cost for land.

There are about 50 miles of distributing mains in the streets of the charter territory. In the thickly built-up sections the streets and sidewalks are paved. This adds to the cost of house connections, because of the item of taking up and replacing permanent pavements.

On the first of July, 1914, the water company sold to the city of Allentown all of its property consisting of a stand-pipe, distributing mains, etc., in the 14th ward, known as East Allentown, which ward was incorporated out of Hanover Township. The price was \$21,000. The stand-pipe cost \$7,500. In this district there were the following water mains, valves and fire hydrants owned and operated by the company and now purchased and owned by the city of Allentown:

Pipe.	Length.	Number of Valves.
1 inch,	316	1
1½ inch,	308	0
2 inch,	172	1
4 inch,	1,860	2
6 inch,	7,570	15
8 inch,	4,820	2

There are six fire hydrants in this district.

I have included this portion of the water works system in the inventory and appraisal because it was included in the appraisal of Stone and Webster and is a part of the plant, the value of which the Commission has been asked to certify.

The Appraisal.

A valuation for a Certificate of Valuation is made somewhat differently than the valuation for rate making. The former would include all of the property of the corporation at its fair value at the time of the appraisal. For instance, the property might comprise numerous lots of lands and dwellings thereon purchased in anticipation of growth in the business but not used or useful at the time in supplying the present patrons with water. Such property would be included in the valuation. There are factors in the general situation, as previously stated, which add materially to the stability of the securities and to the desirability of investments in the utility as a whole. The character of the locality, the class of the population, (the industrial investment and activities, the geographical position, the abundance and potability of the water supply, all must necessarily influence the decision of any one having money invested or contemplating investing money in the Bethlehem Water Company. The Bureau ascertained and determined the fair value of the property of the Bethlehem Water Company, to be the reproduction cost new thereof, namely the sum of \$1,585,272.

CERTIFICATE OF NOTIFICATION.

Sub section (b) of Section IV of Article 3 of the Public Service Company Law provides:

"Every public service company shall file with the commission, on prior to the date of issuance of any stock, trust certificates, bonds, notes, or other evidences of indebtedness or other securities, payable at periods of more than twelve months after the date thereof, and now or hereafter to be authorized (unless upon application as aforesaid, a certificate of valuation shall have been obtained in accordance with the provisions of this Act), a certificate to be known as a Certificate of Notification, in such form as the Commission may, from time to time, determine and prescribe which, among other things that may be required by the commission shall show—

"I. The total amount thereof.

"II. The number and amount thereof outstanding prior to the date of such certificate, the amount thereof theretofore retired, the amount thereof theretofore undisposed of, and whether such amount is held in the treasury of the public service company as a free asset or pledged, and, if pledged, the terms and conditions of such pledge.

III. The number and amount thereof to be issued and the purpose of such issue, and whether to be sold, pledged, or held in the treasury of the public service company as a free asset; if such securities are to be sold, the terms of the sale if a contract for such sale has been made, and, if any part of the consideration to be received therefor is other than money, an accurate and detailed description thereof; if such securities are to be pledged, the terms and conditions of such pledge.

"IV. The number and amount thereof remaining unissued.

"V. If the issue is of shares of stock, the certificate shall also show the par value thereof, and the number of then outstanding shares previously issued.

"VI. The preference of privilege granted to the holders of any such shares of stock, the dates of maturity, rates of interest of any such bonds, notes or other evidences of indebtedness or other securities, and any conversion rights granted to the holders thereof, and the price, if any, at which such shares or such securities may be redeemed.

(c) Whenever any securities, set forth and described in any certificate of notification as pledged or held as a free asset in the treasury of the public service company, shall, subsequent to the filing of such certificate, be sold or repledged or otherwise disposed of by the public service company, such company shall file a further certificate of notification to that effect, setting forth therein all such facts as are required by subdivision III, sub-section (b), of this section four.

(d) All certificates of notification furnished to the Commission shall be signed and verified by the affidavit of the treasurer, auditor, con-

troller, or other acting fiscal head of the public service company. Such Certificates of Notification shall at all times be deemed to be public records, and open to inspection, and may be given such further publicity as the Commission may deem to be for the public interest or welfare."

Titusville Traction Company.

The Titusville Traction Company of the city of Titusville, Crawford County, Pennsylvania, on November 30th, 1914, filed a Certificate of Notification. This under the law was all that it was required to do. The Public Service Commission, for its own information had its Bureau of Engineering make a valuation of the properties of said company. This report showed that the Titusville Traction Company purposed to issue securities and Certificates of Indebtedness considerably in excess of labor done, materials furnished and property acquired. Upon said companies being made acquainted with the result of the Bureau's valuation, it voluntarily reduced in a considerable amount the securities to be issued. The said Certificate of Notification of November 30, 1914, in full was as follows:

Certificate of Notification.

The *Titusville Traction Company* formed by the reorganization of the *Titusville Electric Traction Company*, under the provisions of an Act, entitled "A supplement to an act, entitled 'An act concerning the sale of railroads, canals, turnpikes, bridges, and plankroads' and approved the 8th day of April, 1861, extending the provisions of said act to coal, iron, steel, lumber or oil or mining, manufacturing, transportation and telegraph companies in this Commonwealth," approved the 25th day of May, 1878, and the supplements thereto, in accordance with the provisions of Section 4 of Article III of the Act of the General Assembly approved July 26, 1913, P. L. 1374, defining public service companies and providing for their regulations, etc., proposes to issue its stock and bonds to the respective amounts and for the purposes following, to wit:—

I (a) Common capital stock,	\$250,000		
(b) First mortgage 5% ten year gold bonds,	\$106,000		
(c) Second mortgage 5% ten year gold bonds,	150,000	256,000	
			\$506,000

II There are issued and outstanding of the Titusville Electric Traction Company, being all of the authorized issue thereof:

(a) Common capital stock,	\$300,000		
(b) First mortgage 6% past due gold bonds,	\$100,000		
(c) Second mortgage 6% past due gold bonds,	200,000		
			300,000
			\$600,000

III. The number and amount thereof to be issued and the purpose of such issues is as follows:

(a) \$250,000 of common capital stock to be issued to the persons for and on whose account the franchises and property of the Titusville Electric Traction

Company were purchased, as fully paid and non-assessable stock, upon the conveyance to the new corporation, the Titusville Traction Company, of all of said material, rolling stock, property and franchises of every kind and nature so purchased, by proper deed of conveyance and bill of sale, and accurate and detailed description thereof being as follows:

Ways and Structures:

Engineering and Superintendence,	\$62,297.36
Right of Way,	25,060.19
Other land used in electric operation,	300.00
Grading,	57,164.79
Ballast,	17,000.00
Ties,	25,500.00
Rails, Rail Fastenings and Joints,	110,000.00
Special work,	8,229.93
Track and Roadway Labor,	17,900.00
Paving,	10,470.00
Roadway Machinery and Tools,	250.00
Elevated Structures and Foundations, Bridges, Trestles and Culverts,	12,500.00
Crossings, Fences and Signs,	1,000.00
Telephone and Telegraph Lines, Poles and Fixtures,	6,000.00
Distribution System,	27,306.30
Shop and Car Houses,	8,000.00
Stations, Miscellaneous Buildings and Structures,	2,237.00
Park and Resort Property,	4,517.61
Other Expenditures,	5,500.00

Equipment:

Passenger and Combination Cars,	25,000.00
Freight, Express and Mail Cars,	3,600.00
Service Equipment,	600.00
Electric Equipment of Cars,	10,781.85
Shop Equipment,	1,931.57
Furniture,	1,208.77
Miscellaneous Equipment,	1,500.00

Power:

Power Plant Buildings,	8,000.00
Sub-Station Buildings and Power Plant Equipment,	43,500.00
Sub-station Equipment, Transmission,	4,500.00

General and Miscellaneous:

Franchises, .....	.....
Law Expenditures, .....	.....
Interest During Construction, .....	.....
Injuries and Damages, .....	.....
Taxes, .....	.....
Miscellaneous,	1,644.63
Material and Supplies,	2,500.00

\$506,000.00

(b) \$106,000 *first mortgage* 5% gold bonds, bearing date of July 1st, 1914, and payable on or before July 1, 1924, to be issued to and exchanged with the holders of \$100,000 *first mortgage* 6% gold bonds of the Titusville Electric Traction Company, in exchange therefor and the funding of past interest thereon from July 1, 1913 to July 1, 1914, amounting to \$6,000.

(c) \$150,000 *second mortgage* 5% gold bonds, bearing date of July 1, 1914, and payable on or before July 1, 1924, to be issued to and exchanged pro rate with the holders of \$200,000 *second mortgage* 6% gold bonds of the Titusville Electric Traction Company in exchange therefor.

Upon said exchanges being made, the said first mortgage of \$100,000 and the second mortgage of \$200,000 of the Titusville Electric Traction Company to be discharged and satisfied of record.

IV. None of said stock or bonds are to remain unissued.

V. The par value of the shares of common stock proposed to be issued shall be \$100 and no outstanding shares have been previously issued.

VI. There is no special preference or privilege granted to the holders of any of such shares of stock.

The dates of maturity and rates of interest of the said first and second mortgage bonds proposed to be issued are set out in Paragraph III above, and no conversion rights are granted to the holders thereof, and the price at which such bonds may be redeemed at any interest period before maturity is par and accrued interest.

Titusville Traction Company,

By Harry L. Moore,

Treasurer.

November 30, 1914.

The Bureau of Engineering made an investigation for the ascertainment and determination of the value of the property, for and only for money, labor done, or money or property actually received, for which the bonds, stocks, or other evidence of indebtedness is to be issued. Mr. Richard H. Brodhead was employed to do this work. Mr. Brodhead reported in detail his valuation of the various items as contained in the Certificate of Notification, totaling \$506,000 and reported the valuation thereof to be \$285,828.30. He found that the company had omitted from its inventory a deposit of sand and gravel, which Mr. Brodhead appraised at \$10,000. He also found on hand timber and other supplies which at a low estimate he valued at \$5,000 making a total valuation reported by him for money, labor done, or money or property actually received, the sum of \$300,828.30.

It appears that the original company which built the line was called the Titusville Electric Traction Company. The work was done in 1897. In 1909, a new company was organized to take over the property, which company is now called the Titusville Traction Company. In February 1902, the promoters for the road sold the property to a syndicate of New York men. On or about that time there was about \$50,000 of notes outstanding. The properties, franchises and other assets of the Titusville Electric Company, were sold at Receivers Sale on August 25th, 1914, by order of the Court of Common Pleas of Crawford County. The Titusville Traction Company received its Certificate of Public Convenience on October 22nd, 1914. This new company, in its Certificate of Notification hereinbefore stated, increased from nothing to \$256,000 the common capital stock, and provided for the issue of 2,500 shares of this common stock of the par value of \$100 each. At a subsequent meeting,

held on December 26th, so it is reported, the stockholders and directors authorized the decrease of the capital stock from \$250,000 to \$125,000 or from 2,500 shares of the par value of \$100 each to 2,500 shares of the par value of \$50 each.

On January 2nd, 1915, Mr. Moore, for the said Titusville Traction Company, filed in the office of the Public Service Commission a revaluation of its property in which the capital stock was reduced to \$125,000 and the valuation of the property was fixed at \$381,000 this being the amount of the capital stock and first and second mortgage bonds. So it will be seen that the difference between the valuation made by the agent of the Commission and the valuation made by the company differed by \$80,000, the company's valuation being the higher and being made to equal the proposed issue of stocks and bonds.

The road was built at a minimum expenses, ruling wages at that time being \$1.25 per day for labor. The promoters built the road and then sold out. Subsequently, when the oil industry began to decline, the earning capacity of the road was impaired to such an extent that it appeared necessary to extend it and connect with Cambridge Springs, Meadville and on to Edinboro and Erie. A company was formed for this purpose which did considerable grading between the present end of the line and Cambridge Springs, the idea being to effect a consolidation with the Titusville Company. The project was not consummated, however, and this left the said Titusville Company with its present line. This company has been operating under adverse circumstances, since it has to depend upon local traffic in and out of Titusville and a limited amount of passenger and express traffic between Titusville and Pleasantville, a village of about 1,000 people, dependent almost entirely upon the transportation facilities of the company. During the summer months there is considerable amount of business to a resort called Mystic Park located on Oil Creek and to a resort on the line to Pleasantville, called Field Moore Park.

VALUATIONS FOR RATE MAKING.

Beaver Valley Water Company.

The Beaver Valley Water Company and its allied companies viz: College Hill Borough Water Company, Patterson Heights Water Company, Union Water Company, New Brighton Water Company, Fallston Water Company, West Side Water Company, Valley Water Company of Rochester, North Rochester Water Company and Freedom Water Company serve a territory lying on both sides on the Beaver River from and including College Hill borough to the Ohio River, a distance of about 5 miles and along the east bank of the Ohio River, a distance of about 4 miles, terminating at the borough of Conway which is 22 miles below Pittsburgh. The various municipalities, thus served lie wholly within Beaver County and comprise the boroughs of Conway, Freedom, East Rochester, Rochester, Bridgewater, New Brighton, Patterson Heights, Rochester Township and the city of Beaver Falls and College Hill. The total population in these municipalities, according to the 1910 census was 35,237. In addition to the domestic consumers of water, the company has as its patrons many of the large industries to whom water is supplied for both industrial and drinking purposes.

The original Beaver Valley Water Company was incorporated June 28th,

1889, to supply water to the public in the valleys of the Beaver and Ohio River, excepting the borough of New Brighton. This company was dissolved July 12th, 1899. On November 1st, 1901, the Conway Water Company was incorporated to supply water to the public in the township of Conway. On April 25th, 1902, the name was changed to the Beaver Valley Water Company and on May 1st, 1902, it acquired by purchase the pumping station, trunk lines and two reservoirs of the Freedom Water Company; the trunk line of the North Rochester Water Company; the trunk line and stand-pipe of the Beaver Valley Water Company of Rochester; the trunk line of the West Side Water Company; the pumping station, filtration plant, trunk line and reservoir of the New Brighton Water Company; the pumping station, filter plant, trunk line and reservoir of the Union Water Company; and the pumping station, trunk line, reservoir and stand-pipe of the College Hill Borough Water Company. Subsequently, on June 5th, 1902, the Beaver Valley Water Company purchased from the newly incorporated Patterson Heights Water Company, its trunk line and stand-pipe, and on March 31st, 1903, the trunk line of the newly incorporated Fallston Water Company. Co-incident with these various purchases, a 999 year lease was entered into by each of said water companies with the Beaver Valley Water Company, so that at the present time the Beaver Valley Water Company owns all the reservoirs, pumping stations, filter plants and trunk lines, and operates the same. The subsidiary companies own the separate distribution systems in their respective territories. All bills are sent out in the name of the Beaver Valley Water Company as the operating concern and all contracts are made in the name of that company.

In 1913, the Beaver Valley Water Company sold that portion of its distribution system lying in the borough of Conway, to the borough which now has its own source of supply from driven wells on the east bank of the Ohio River. In times of drought, however, it is the custom of the borough to purchase water from the Beaver Valley Water Company, a physical connection between the two systems being maintained for this purpose. Under the present conditions, therefor, the Beaver Valley Water Company is not supplying water continuously to that portion of its charter territory within Conway borough.

The Beaver Valley Water Company has three sources of supply; one on the Ohio River at Freedom, one on the Beaver River at New Brighton and one on the Beaver River at Eastvale.

Pumping Stations and Filter Plant.

The following is a description of the pumping stations and filter plants as they existed in August 1915:

The Freedom plant, acquired from the Freedom Water Company on May 1st, 1902, has not been used since October 15, 1903. Formerly water was taken from a 16 inch and a 12 inch suction line from the Ohio River into a pump well 10 feet in diameter and 45 feet deep, from which the suction pipes from two centrifugal pumps, having a combined capacity of 3,000,000 gallons per day, led to a settling basin 16 feet in diameter and 30 feet deep. From the settling basin, three pumps, a Gould rated at 500,000 gallons a day, and two Deming pumps, each having a capacity of 350,000 gallons per day, operated by three 50 H. P., one 40 H. P., gas engine delivering the water directly into the mains. At present all valves leading from the pumping station are locked, sealed and the key is in the hands of the local board of health. However, while the pumping station is kept in repair, ready for use, some of the connections have been severed, so that it would be a matter of a day or so before the station could be put in commission.

The New Brighton plant is operated in connection with the New Brighton dam. It consists of a head race, pumping station, sedimentation tank and a filtration plant located on the east bank of the Beaver River at the foot of Ninth Street in New Brighton. The pumping station and filtration plant are housed in two buildings, one called the Bentley Station and the other the New Brighton Station. About 250 feet above the Bentley Station is the dam approximately 14 feet high from which a head race supplies water for the operation of the turbines and for the filter plant. In the New Brighton Station is installed a 3,000,000 gallon Lawrence Machine Company centrifugal pump, actuated by a 19 inch new American Turbine taking water from the head race and discharging it through a 10 inch main into an open sedimentation tank, 50 feet in diameter and 20 feet high, having a working capacity of 275,000 gallons. This pump may also be operated by steam in case of emergency.

The sedimentation tank is cylindrical with a conical base to aid in the collection and rejection of sediment. The inlet enters into the conical base and the outlet is located 4 feet below the top of the tank. Since the draft from this plant during 1914, was approximately 2,250,000 gallons per day, it is evident that the tank holds a supply equivalent to about 3.75 hours and that the amount of sedimentation is considerable less than best practice requires considering that there are no baffles and that a decided whirling effect is noticed.

In the Bentley Station an auxiliary 3,000,000 gallon centrifugal pump, actuated by a 19 inch new American turbine, is held in reserve for raw water pumping.

In 1913, plans were approved for two new concrete sedimentation basins of a combined capacity of 755,000 gallons, but the work has not been done due to the fact that important changes in the track alignment of the Pennsylvania Railroad nearby involved the proposed location of the basins. From the sedimentation tank a 14 inch pipe carries the water by gravity to the filtration plant, which consists of 7 filter units of the mechanical rapid sand type, chemical feeding tanks and a clear water basin. Of the filter units 5 were constructed in 1904, by the Pittsburgh Filter Manufacturing Company and they are of concrete 10 feet wide, 20 feet long and 8 feet deep and have a capacity of 400,000 gallons per day each. The other two units were built in 1907 by the same company and have a capacity of 750,000 gallons per day. The filters are equipped with hemispherical, perforated strainers. Each filter has 32 inches of sand and 12 inches of gravel. All units are supplied with a separate air system placed immediately under the gravel bed. Air is supplied by means of Pelton water turbine driving a blower which furnishes air at the pressure of about 4 pounds. Wash water is furnished from an elevated tank 20 feet in diameter and 25 feet high, capacity 58,000 gallons, supply from the high pressure mains. All filters were originally equipped with rate controllers and loss of head gages, but all of this equipment is now removed. The coagulant plant consists of two steel tanks 6 feet in diameter and 6 feet high located in the filter building. The coagulant is fed by gravity into the pipe discharging to the sedimentation basin. The amount of alum used varies from .087 grains per filtered gallon to 2.2 grains with an average of about .7 grains. Hypochlorite is fed at an average of about 11 lbs. per million gallons into the raw water before it reaches the sedimentation basin. The mixing and control of this germicide is controlled by hand.

Two concrete clear water basins are provided, one directly under the filters, 1 to 5, being 55 feet by 20 feet by 11 feet deep, with a capacity of 90,000 gallons, and a second, much smaller, under the high pressure pump in the Bentley Station. These two basins connected by a 16 inch pipe are in reality merely pump wells.

From the clear water basin water is pumped directly into the distribution system by means of a 2,600,000 gallons Wilson and Snyder pump, operated by a 54 inch New American turbine, working under a 16 foot head and located in the Bentley Station; and by a 1,500,000 gallon Barr pump operated by a 48 inch New American turbine; and a 3,000,000 gallon Wilson and Snyder compound triple expansion steam pump located in the New Brighton Station. An emergency intake leading directly from the river to the high pressure pumps is maintained but never used. The entire New Brighton plans was out of commission for 36 days during the flood of 1913.

The Eastvale filter plant is located on the east bank of the Beaver River in Eastvale borough. Water is taken from a head race leading from above the Hartman dam by a 10 inch, 5,000,000 gallon Boggs and Clark centrifugal pump actuated by a 48 inch New Success turbine, or by a 70 H. P. Russel gas engine. From this pump an 8 inch line crosses under the tracks of the Pennsylvania Railroad through a concrete tunnel 5 feet by 6 feet dimensions, to a reinforced concrete sedimentation basin 110 feet long, 50 feet wide by 15 feet effective depth, having a normal capacity of 600,000 gallons. From the sedimentation basin, after a period of about 3 hours settling, the water flows by gravity through a 20 inch pipe to the filters which are of the mechanical rapid sand type. The filtration plant consists of 10 filter units, 6 of the old style jewel type and 4 of the jewel pressure type converted into gravity unit. The 4 pressure units, installed in 1892, by the New York Continental Jewel Filtration Company, are closed cylindrical steel tanks 10 feet in diameter and 22 feet long. During the summer of 1910, they were converted into the gravity type and at present are supported in a horizontal position on concrete foundations. It is claimed that the maximum capacity of each filter unit is about 500,000 gallons per 24 hours. These 4 units are without loss of head gages or rate controllers. Their outlets are submerged in the clear water basin and it is possible for the units to work under a negative head. Filter units No. 1, 2 and 3 were installed in 1900 and Nos. 8, 9, and 10, in 1902. They are the old style, wooden tank, gravity type. At present air is introduced through the collecting manifold under about 4 pounds pressure. Wash water is supplied from a tank receiving its supply from the high service main. There are no loss of head gages or rate controllers on any of these units. Alum is used as a coagulant and the solution tanks, two in number, 5 feet in diameter and 6 feet high, are located in the rear of the storage room. The solution is fed by gravity into an orifice box from which the dose is carried to the raw water main. The amount of lime used is regulated as at the New Brighton plant by the operator manipulating a hand valve. The hypochlorite disinfectant is introduced into the clear water well. The amount of alum used in 1915, ranged from .32 to 1.00 grains per gallon and the hypochlorite average about .04 grains per gallon, or 6 pounds per million gallons of water filtered. A clear water basin 115 feet long by 45 feet wide by 18 feet deep, with a capacity of 400,000 gallons, is located under the filter units.

The high service pumping equipment consists of three 2,000,000 gallon Wilson and Snyder pumps, two operated by a 40 inch New Success turbine and one by a 52 inch New American turbine; one 4,000,000 gallons Epping Carpenter compound triple expansion pump; and also one 3,000,000 gallon Wilson and Snyder steam pump used as an auxiliary.

The Eastvale plant has an emergency intake from the river to the town service pump but it is never used.

Trunk Lines.

The main trunk line of the Beaver Valley Water Company is a 16 inch pipe about 24,000 feet long extending from the Eastvale pumping station along the east bank of the Beaver River to Trough Run, thence to and along Ellwood City Road to Penn Avenue, New Brighton; thence to and along Third Avenue, Rochester, and to and along Delaware Avenue to Piney Street, Rochester; and of about 20,000 feet of 12 inch pipe, extending from the corner of Madison Avenue and Piney Street, Rochester, along Piney Street and K Street to Third Street, Freedom, and thence along Third Street to Sixth Avenue to Eighth Street to Fifth Avenue, and along Fifth Avenue to Chaney Street, Conway borough.

Two trunk lines, one 16 inches and one 12 inches in diameter cross from the Eastvale Station under the Beaver River to Sixth Avenue and 22nd Street in Beaver Falls; thence along 22nd Street to Ninth Avenue. From this point two 12 inch lines, one along Ninth Avenue and the other along Eighth Avenue extend from 22nd Street to the College Hill borough line; and a 12 inch line extends along Sixth Avenue from 22nd Street to Third Street, all in Beaver Falls. A 10 inch line extends from Ninth Avenue and 22nd Street to the old Mt. Washington reservoir on the hill above Beaver Falls.

From Beaver Falls at the College Hill borough line, 12 inch lines extend along Eighth and Ninth Avenue, combining in College Hill and continuing along Ninth Avenue to 30th and up 30th to the College Hill reservoir.

A 6 inch line about 4,000 feet long extends from Third Street in Sixth Avenue in Beaver Falls to the Patterson Heights tank.

From the New Brighton pumping station a 16 inch pipe extends to the corner of Third and Tenth Streets and from that point about 4,500 feet of 14 inch pipe extends along Tenth Street to Fourth Avenue to 17th Street and along Seventeenth Street to Fifth Avenue, connecting there with the 16 inch main from Eastvale.

From the 14 inch line at the corner of Fourth Avenue and Tenth Street in New Brighton, a 12 inch line about 6,500 feet long extends along Tenth Street to Sixth Avenue, thence along Sixth Avenue to and across and beneath the Beaver River connecting with the 12 inch line at the corner of Third Street and Sixth Avenue in Beaver Falls.

From the foot of Fifteenth Street in New Brighton, about 500 feet of 8 inch line extends under the river to Fallston borough.

From the 16 inch trunk line at the corner of Madison Avenue and Piney Streets, Rochester, a 10 inch line about 3,000 feet long extends to the Rochester tank in the rear of Reno Street.

From the 16 inch trunk line at the corner of Madison Street and Delaware Avenue in Rochester, an 8 inch line about 1,000 feet long crosses the river to Bridgewater.

In Freedom borough a 12 inch line about 1,000 feet long extends from the Freedom pumping station along Eleventh Street connecting with the 12 inch trunk line from Eastvale to Conway. An 8 inch line extends along Third Avenue from the 12 inch trunk line from Eastvale, connecting again with this trunk line at the corner of Fourth Avenue and Fourteenth Street. An 8 inch line extends along Eleventh Street from the Eastvale trunk line to the Freedom reservoir beyond Ninth Avenue.

Reservoirs and Tanks.

The reservoir system of the Beaver Valley Water Company comprises 5 reservoirs and 3 elevated tanks. In the extreme northern part of the system is situated the College Hill reservoir, a brick lined structure with puddle sides, 360 feet long by 190 feet wide by 10 feet deep with a capacity of about 3,000,000 gallons. A single 12 inch pipe serves as an inlet and outlet and hence the reservoir acts merely as a regulator. The bottom is 159 feet above the Eastvale pumping station. The reservoir serves nearly all of Beaver Falls and New Brighton.

Inasmuch as part of the borough of College Hill is too high to permit of service from this reservoir, a covered iron tank has been provided, 18 feet high and 20 feet in diameter, capacity 60,000 gallons, located on the east bank of the reservoir and 90 feet above the ground. Water for this high service is taken from the 12 inch trunk line and is lifted by a Wilson and Snyder pump operated by a New Era gas engine and discharged directly into the mains, the tank acting merely as a regulator.

In Beaver Falls at the head of Twenty-first Street is located the Mt. Washington reservoir, a brick lined structure with a capacity of about one million gallons. It is used merely for auxiliary storage, being closed off by valves from the distribution system. Its bottom is elevated 250 feet above the Eastvale Station.

At Patterson Heights a wooden tank with a capacity of 125,000 gallons is supported on a re-inforced concrete tower. Water to this tank is supplied by a Deming triplex pump, capacity 150,000 gallons per day, actuated by a 25 H. P. Champion gas engine. This booster station is operated between two and five hours per day and pumps directly into the service main, the surplus going to the tank. The elevation of the bottom of the tank is about 420 feet above the Eastvale Station.

On the Ellwood City Road in Daugherty Township, just outside of New Brighton borough is located the New Brighton reservoir. It is constructed of rubble wall masonry with brick bottom, is 74 feet square and 9 feet deep, capacity 375,000 gallons. It has not been in use since 1905, and an inspection of the walls and sides leads to the conclusion that extensive repairs are necessary.

North of Reno Street in Rochester borough is located the Rochester Steel tank. It is 20 feet high and 25 feet in diameter and has a capacity of 60,000 gallons. This tank is 88 feet above the ground and 265 feet above the Eastvale Station. It receives the surplus water from the distribution system and hence acts only as an equalizer. On the hill back of Freedom borough are located two reservoirs. One reservoir is 180 feet long by 150 feet wide and 15 feet deep, capacity 2,000,000 gallons. It is elevated 200 feet above the borough of Freedom and 215 feet above the Eastvale Station. The sides and bottom are lined with concrete. The second reservoir is located 15 feet higher than the first, it is brick lined and has a capacity of 500,000 gallons. It has not been in service since 1903, owing to the fact that the larger reservoir is sufficient in capacity and head.

Engineering Conferences.

Complaint was made to the Commission against the rates and service of the Beaver Valley Water Company. At the first hearing before the Commission it appearing that the questions involved resolved themselves primarily into a determination of the fair value for rate-making purposes of the property of

the company, the Chief Engineer was directed to preside at a conference of the experts of the complaints and of the respondent. Such a conference was held in September, 1914, at Beaver Falls. The following persons were in attendance at this conference:

James P. Leaf, Engineer,
M. M. Maneese, Engineer,

Representing the Complainants.

L. E. Chapin, Engineer,
George W. Fuller, Consulting Engineer,
Morris Knowles, Consulting Engineer,
E. F. Black, of Sanderson & Porter, Engineer Accountant,

Representing the Respondent.

and the writer, assisted by C. J. Joyce, the Commissioner's Auditor, representing the Public Service Commission. The conferees made an examination of the physical property as enumerated in the detailed inventory as of March 31st, 1914, and offered in the case as Exhibit No. 10. The conference did not take into account, water power nor water rights, intangible property, nor anything not contained in the inventory. Furthermore, in arriving at a valuation of the items contained in the inventory, reproduction cost new was the determination. Consequently, depreciation was left to be determined by the Commission after testimony relative thereto is offered. The conference agreed as to the cost new of items aggregating \$984,018.16. We were unable to reach an agreement with respect to five items, representing the remainder of the inventory, namely:

- 1—The cost of replacing street pavements over pipe lines and hydrant leads.
- 2—The cost of the Hartman dam and west abutment.
- 3—The cost of the interest of the Beaver Valley Water Company and underlying companies in the dam, headgates and race of the New Brighton Water Company.
- 4—The proper charges for overhead expenses during construction.
- 5—The proper charges for interest on money and investments during the construction period.

The cost of replacing street pavements over pipe lines and hydrant leads, mentioned as No. 1 above, is included in the value of the trunk lines and distribution systems by the respondent company in its answer to the complaint. The items as mentioned as No. 4 and 5 above, are included in the values of tangible property in the answer of the respondent company to the complaints.

The total of \$984,018.16, agreed upon as the cost new, was made up of the following items:

1—Trunk lines and distribution systems,	\$521,776.16
2—Reservoirs and tanks,	63,750.00
3—Power and filtration plants,	382,800.00
4—General properties,	13,492.00
5—Meters owned by the water company,	2,200.00
	<hr/>
	\$984,018.16

While the representatives of the complainants agreed with the representatives of the respondent that it would cost to reproduce new \$521,776.16 for

all the trunk lines and distribution systems, they maintain that \$91,670.18 of this item represented properly not used or useful, or that this amount should be excluded in whole or in part from the valuation of the utility for rate-making purposes, and similarly they maintained that \$7,000 should be excluded from the reproduction cost new as above of reservoirs and tanks and that \$68,500 should be excluded from the reproduction cost new as above of the power and filtration plant, making a total of \$167,170.18 for these three items about which they wish to be further heard before the Public Service Commission. These sums deducted from the total sum leaves the following valuation of the said five items with respect to which there is no contention.

1—Trunk lines and distribution system,	\$430,105.98
2—Reservoirs and tanks,	56,750.00
3—Power and filtration plants,	314,300.00
4—General properties,	13,492.00
5—Meters owned by the company,	2,200.00
Total,	\$816,847.98

With respect to the exceptions taken to the total reproduction cost new of trunk lines and distribution systems, the amount excepted to being \$91,670.18, in the following tabular statement is shown the location of these lines, their length and diameter, cost new agreed upon and with respect to what the exception is noted:

Location.	Property.	Cost New. Agreed Upon.	Exception with Respect to.
Rochester Township,	9,200 ft. 16 in.	\$25,350 00	Usefulness.
New Brighton,	4,375 ft. 14 in.	10,258 78	Usefulness.
Freedom and Conway,	8,470 ft. 12 in.	14,822 50	Rate making.
Beaver Falls,	50,250 ft. 8 in. }		
	6 in. }		
	4 in. }	39,333 00	Rate making.
Conway,	Valves and boxes }	1,035 40	Rate making.
	extra rock excavation. }	949 50	Rate making.
Total,		\$91,670 18	

The item of \$39,333 as cost new for 50,250 feet of distributing pipe needs to be briefly explained. In Beaver Falls at one time there were two water companies operating, and in consequence on a number of streets, parallel lines of pipes existed. After the two companies were consolidated, no change was made, except in the manner of operating these pipes, and they are to-day both being used. Some of the abutting properties take their service from one pipe line and some of the abutting properties take their service from the other pipe line in the same street. The size, length and cost new of these duplicated pipes, which in the opinion of the representatives of the complainants should not be included in the valuation for rate making purposes, are shown in the following tabular statement:

Size.	Length.	Cost New.
	Feet.	
8 inch,	1,770	\$2,035 50
6 inch,	27,550	23,693 00
4 inch,	20,930	13,604 50
Total,	50,250	\$39,333 00

In each instance, where the duplicate lines of pipe exist, the representatives of the complainants have allowed the larger sized pipe as proper to be included in the valuation for rate-making. In the said 50,250 feet of duplicate lines, to which exception is taken, there are gate valves, check valves and boxes, aggregating \$1,006.40 to which the said representatives of the complainants necessarily make exception.

With respect to the exceptions taken to the second classification, namely, reservoirs and tanks, amounting to a total cost new of \$7,000 the details are given in the following tabular statement:

Location.	Property.	Cost New Agreed Upon.	Exceptions With Respect to
New Brighton,	Reservoir,	\$4,000 00	Rate making.
Freedom,	Upper reservoir,	3,000 00	Rate making.
		\$7,000 00	

With respect to the exceptions taken under the third classification—power and filtration plants—amounting to a total value new of \$68,500.00, the location, property, cost new agreed upon and the nature of the exceptions are given in the following tabular statement:

Location.	Property.	Cost New Agreed Upon.	Exceptions With Respect to.
New Brighton,	Bentley Pumping plant,	\$50,000 00	Rate making.
Freedom,	Pumping Station,	13,500 00	Rate making.
Beaver Falls,	Peoples Pumping Station warehouse,	5,000 00	Rate making.
	Total,	\$68,500 00	

Signed Agreement.

The conference made its findings and agreements in writing and the members affixed their signatures thereto. The following is a copy of it:

In the Matter of the Petition of Certain Patrons of the Beaver Valley Water Company Relative to Rates and Service of said Company, before the Public Service Commission of the Commonwealth of Pennsylvania.

Beaver Falls, Pa., September 26, 1914.

FINDINGS AND AGREEMENT of L. E. Chapin, Engineer and George W. Fuller, Consulting Engineer, representing the Beaver Valley Water Company; and James P. Leaf, Engineer, and M. M. Maneese, Engineer, representing the complainants; and F. Herbert Snow, Chief of the Bureau of Engineering, and C. J. Joyce, Chief of the Bureau of Accounts and Statistics, of the Public Service Commission of the Commonwealth of Pennsylvania, meeting in Beaver Falls for the purpose of examining the work of the said Beaver Valley Water Company and of examining the detailed inventory of the physical property of the said company, exhibit No. 10; and of arriving at an agreement with respect to said inventory and the cost of reproduction new of the items therein contained.

After a physical examination of the works and a study of the inventory, -

it is hereby and herein agreed that the cost new of the following named items, in total are the sums placed opposite each item, aggregating \$984,018.16:

Trunk lines and distributing systems,	\$521,776.16
Reservoirs and tanks,	63,750.00
Power and filtration plants,	382,800.00
General properties,	13,492.00
Meters owned by the water company,	2,200.00

Total,	\$984,018.16
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The above total of \$984,018.16 includes items aggregating \$30,742.00 on which it has been agreed that no overhead charges shall be made, which items are as follows:

College Hill tank,	\$3,500.00
Patterson Heights tank,	4,750.00
Rochester tank,	3,000.00
Beaver Falls storehouse,	1,000.00
Peoples pumping station warehouse,	5,000.00
General properties,	13,492.00

Total,	\$30,742.00
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There are certain items contained in the above sum of \$984,018.16 amounting in the aggregate to \$167,170.18, as reproduction cost new, to which the representatives of the complainants reserve the right to produce testimony before the Commission with respect to whether these items, in part or in full, shall be included in the valuation of the utility for rate making purposes. These items, a memorandum of the details of which is attached hereto, amount to the following sums:

Trunk lines and distribution system,	\$91,670.18
Reservoirs and tanks,	7,000.00
Power and filtration plant,	68,500.00

Total,	\$167,170.18
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No agreement has been reached with respect to the following five items, representing the remainder of the inventory, namely: the cost of replacing street pavements over pipe lines and hydrant leads; the cost of Hartman dam and west abutment; the cost of the interest of the Beaver Valley Water Company and underlying companies in the dam, head gates and race of the New Brighton Water Company; the proper charges for overhead expenses during construction; and the proper charges for interest on money and investments during the construction period.

IN TESTIMONY HEREOF, we severally affix our signatures:

L. E. Chapin,
 Geo. W. Fuller,
 James P. Leaf,
 M. M. Maneese,
 F. Herbert Snow,
 C. J. Joyce,

The memorandum above referred to was also signed and the following is a copy of it:

In the Matter of the Petition of Certain Patrons of the Beaver Valley

Water Company Relative to Rates and Service of said Company, before the Public Service Commission of the Commonwealth of Pennsylvania.

Beaver Falls, Pa., September 26, 1914.

Memorandum of detail structures of the Beaver Valley Water Company and underlying companies, as to which the representatives of the complainants reserve the right to contend before the Commission as to the usefulness of said structure and as to the reasonableness of excluding them, in whole or in part, from the valuation of the utility for rate making purposes.

The items, which amount to a total value, cost new, of \$167,170.18, are stated in the following table:

Trunk lines and distributing systems,	\$91,670.18
Reservoirs and tanks,	7,000.00
Power and filtration plants,	68,500.00
Total,	<u>\$167,170.18</u>

In Rochester Township, 9,200 feet of 16 inch pipe, the diameter of which is claimed to be unnecessarily large. The cost new of the pipe is \$25,300 agreed upon.

In New Brighton borough, there are 4,375 feet of 14 inch pipe, cost new agreed upon \$10,258.78, with respect to which there is a question as to size and utility.

In Freedom borough and Conway borough there are 8,400 feet of 12 inch pipe, cost new agreed upon, \$14,822.50. In Beaver Falls borough there are a number of streets upon which two lines of distributing pipe are laid and in service. The size, length and cost new of these pipes, agreed upon, are as follows:

8 inch,	1,770 feet	\$2,035.50
6 inch,	27,550 feet	23,693.00
4 inch,	20,930 feet	13,604.50
Total,	<u>50,250 feet</u>	<u>\$39,333.00</u>

The claim of the representatives of the complainant with respect to these lines is that their cost should not be included in the valuation of the water works system for rate making purposes. In each instance, the larger of these duplicate pipe lines in each street has been accepted by the complainants as the one upon which the valuation for rate making purposes should be made.

On the streets, where there are duplicate pipe lines to which exception has been made, there are valves, check valves and boxes, the cost new of which is \$1,006.40, agreed upon; consequently, exception is also taken to this item being included in the valuation of the utility for rate-making purposes. Furthermore, in Conway borough, along the line of the 12 inch pipe, there is an item of \$949.50 for extra rock excavation, agreed upon as to cost, to which exception is made on the basis that this should not be included in the valuation of the utility for rate making purposes.

With respect to reservations under item—reservoirs and tanks—the New Brighton reservoir is estimated to cost new \$4,000 and the upper Freedom reservoir \$3,000. The representatives of the complainants maintain that the cost of these two reservoirs should not be included in the valuation of the utility for rate making purposes.

With respect to the reservations noted under item—power and filtration

plant—it is agreed that the cost new of the Bentley pumping plant is \$50,000, exclusive of superstructure and that the Freedom pumping station, cost new is \$13,500; and that the Peoples pumping station warehouse, cost new is \$5,000. The representatives of the complainant contend that each and every one of these physical properties mentioned in this paragraph should not be included in the valuation of the utility for rate making purposes.

IN TESTIMONY WHEREOF, we severally affix our signatures:

L. E. Chapin,
Geo. W. Fuller,
James P. Leaf,
M. M. Maneese,
F. Herbert Snow,
C. J. Joyce,

Conclusions.

At the conclusion of the year covered by this report, the trial of this case before the Commission had not been concluded.

THE WESTMORELAND WATER COMPANY OF GREENSBURG.

On August 4th, 1914, certain citizens and taxpayers and consumers of the Westmoreland Water Company in the borough of Greensburg, Westmoreland County, Pennsylvania, filed a complaint with the Public Service Commission, representing that since January 1st, 1914, the water company has been collecting charges according to a schedule of rates adopted December 27th, 1913, and filed with the Public Service Commission May 12, 1914, which rates are alleged to be more than double the rates charged by other water companies in the State under substantially similar conditions; also that such rates are unjustly discriminatory against consumers of small amounts of water and unreasonably preferential in favor of large consumers; furthermore, that the rates for fire protection charged the borough are excessive, since prior to January 1st, 1914, the charge was \$5,000 per annum, and since, the charge is over \$9,000 per annum; that respondent does not furnish an adequate supply of water at sufficient pressure and has refused to remedy such defective service and has failed to furnish in certain sections of the borough pure water at certain times; and it is further represented that the water company has denied the petitioners access to the books and accounts of said company, and that the petitioners are unable to employ experts to value the water works system, and hence the petitioners request that the Public Service Commission inquire and determine whether the charges for domestic service and fire service are excessive, discriminatory and preferential, etc.

The Commission gave a hearing on October 9th, 1914, to the parties in interest, and at the conclusion it was agreed that the Engineer for the complainant and the engineer for the respondent should meet the Chief of the Bureau of Engineering of the Commission to go over the question of valuation of the water works as presented by the respondent. Such facts as could be agreed upon were to be noted and the balance on which no agreement could be reached were to be presented with my judgment thereon, in a report to the Commission for its consideration.

(Preliminary Meeting of Engineers at the Borough of Greensburg.)

Early Monday morning, October 26th, - the following representatives came to the rooms of the Chief Engineer of the Commission at Hotel Rappe at Greensburg:

For the petitioners, the following attorneys:

P. H. Gaither,
C. E. Whitten,
H. H. Fisher,
R. V. Laird.

For the water company:

W. A. Hoff, President,
D. L. Dillinger, Treasurer,
L. B. Smith, Manager,
Morris Knowles, Consulting Engineer,
W. C. Hawley, Consulting Engineer,
Mr. Scharff, Assistant to Mr. Knowles,
R. W. Smith, Attorney.

Mr. Gaither said the petitioners were not prepared to go ahead. He did not object to engineers conferring about the physical plant of the water works system, but he did object to a determination of the value of the works on a theoretical basis and it would be useless for their engineer to meet with other engineers for such a purpose, since the petitioners did not agree to abide by any conclusion that their engineer might reach at this time. What the petitioners want to know is the actual cost of the works as determined from an examination of the books and accounts of the company, with respect to the plant built for and used by the public in the borough of Greensburg. With respect to the other districts served by the same company, the petitioner has no concern. Furthermore, the cost is in the possession of the company, but access to the books and accounts is denied the petitioners. Therefore, it is the bounden duty of the Commission to make a diligent search of such accounts and to determine the cost of the work in this manner. When the results have been secured by the Commission, it is then quite possible that the petitioners will instruct their engineer to enter into conference with the other engineers to fix a value on such portions of the works with respect to which there are no cost accounts in existence.

In answer, the agents of the water company stated that the accounts for the entire system, including all the districts of which Greensburg is one, are kept in one office, and that the company objects to placing before the petitioners its accounts with respect to these other places that do not concern the public at Greensburg, but the company's books and accounts of all kinds and for all places are open for inspection and use of the Commission or its agents. Furthermore, the company now has experts at work tabulating many hundred vouchers respecting the original cost of the system and that when this work is finished, which will take about three weeks longer, the results will be placed in the hands of the petitioners.

In answer to this, Mr. Gaither, said that the Commission should not be satisfied with anything short of an examination of the books and accounts by agents of the Commission, and the petitioners would insist that such a search be made by the Commission. However, he was willing that his engineers and the company's engineers make a view of the physical property of the company pertaining to Greensburg because the engineer of the Commission insisted that this inspection could be done at that time to no disadvantage and some advantage.

age. Consequently, and while waiting for the petitioners' engineers to appear, the remainder of Monday was spent in a view of Indian Creek reservoir and the watershed thereof, and the means by which this water is furnished in part to the Westmoreland Water Company by the Mountain Water Supply Company, a subsidiary to the Pennsylvania Railroad Company. This inspection party comprised W. A. Hoff, L. B. Smith and J. B. Gallagher of the water company, Messrs. Knowles, Hawley and Scharff and Mr. Spencer, Manager of The Mountain Water Supply Company, who is stationed at Greensburg, and F. Herbert Snow.

Tuesday morning the following engineers representing the petitioners, appeared: C. W. Knight, of Rome, N. Y., W. G. Muse of West Newton, Pa., and now County Commissioner, and E. L. Zearley of Uniontown. These gentlemen with Messrs. Smith, Gallagher, Knowles, Hawley and Scharff of the water company and F. Herbert Snow spent the day in an examination of the Immel reservoir and its sources of supply on Chestnut Ridge reservoir, the Unity reservoir and Booster pumping station, the Dry Ridge distributing reservoir, the Jeannette reservoir and the Booster pumping station at the Indian Creek pipe line near Youngwood. The condition of the plant was noted, also the capacity, mode of operation and necessity for additions, extensions and improvements.

Upon returning to Harrisburg, I urged the Commission to direct its auditor to make an examination of the books and accounts of the water company, because until this is done, it would appear that the petitioners would refrain from participating in a conference of engineers.

The General Situation.

In the following pages will appear a description of the water works substantially as they existed when this case was brought up subject to corrections and reviews as to lengths and size of pipes, number of hydrants and consumers of water as may be finally necessary at the conclusion of the trial of the case.

The borough of Greensburg is the largest municipality of a chain of boroughs that is supplied with water by the several Westmoreland Water Companies, all operated under one management. The original works were built for Greensburg, the source of supply was several streams from the forested areas of Chestnut Ridge Mountain. The waters are soft and pure and desirable. They were sufficient in quantity as impounded at the Immel Reservoir to meet the needs of Greensburg but not for Greensburg and all the other places that are now supplied from this source when there is enough water. It has cost large sums of money to build the metropolitan system which serves all of the places. The people of Greensburg take the position that they are possessed of the first right to this mountain water. They question the purity of and object to being supplied from the other sources. Furthermore, they maintain that the present water rates are not necessary for the works essential to the needs of Greensburg excluding the cost of getting water from the other sources. Hence, Greensburg was not willing at first that the other boroughs shall be a party to Greensburg's petition.

The water company has built a system to serve the needs of the entire metropolitan district with no special reference to any particular place in it other than that all such places shall have proper domestic and fire protection service. As this case proceeds, therefore, either one side or the other will bring before the Commission for consideration the water works system in its entirety, both as to cost, service, necessary extensions and the rates.

General Description of Territory in Question.

There are nine boroughs and six villages in the territory in question and in this territory there are four operating water companies as follows: The Westmoreland Water Companies, the Standard Water Company and the Consumers Water Company of North Huntingdon Township, Also the North Irwin Water Company of North Irwin borough.

Population.

The population in these places is shown in the following table:

Place.	Population. 1910 Census.	Water District.	Increase since 1900.	Estimated 1915 Population.
Greensburg Boro,	13,012	Greensburg,	3,933	Greensburg District, ... 24,000
Irwin,	2,885	Irwin,	434	Irwin District,
Jeannette Boro,	8,077	Jeannette,	2,212	Jeannette District, ... 13,000
Manor Boro,	1,039	Jeannette,	355	
North Irwin Boro, ...	646	Irwin,	213	
Penn Boro,	1,048	Jeannette,	285	
South Greensburg Boro,	10,743	Greensburg,	1,018	
Southwest Greensburg borough.	2,127	Greensburg,	1,296	
Youngwood Boro,	1,881	Greensburg,	1,902	
Carbon village,		Greensburg,		
Fosterville village, ...		Greensburg,		
Huff village,		Greensburg,		
Pleasant Unity village,		Not supplied,		
Westmoreland city, ...		Jeannette,		
Whitney village,		Greensburg,	1,250	

Location.

The territory is in the central western part of Westmoreland County along the main line of the Pennsylvania Railroad from Greensburg near the headwaters of Jacks Run, tributary of the Youghiogheny River, to Irwin, on Brush Creek, a tributary of Turtle Creek; and from Greensburg to Youngwood. Also on the Pittsburgh, McKeesport and Greensburg Railway and the Western Penn Railways. Whitney village is 2 miles north of Immel Reservoir.

Industries.

The industries are coal mining and coke manufacturing. Also glass works and rubber works at Jeannette.

Water Supply.

The Westmoreland Water Company, incorporated 1886 for Ludwick borough (now 6th ward of Greensburg) purchased in 1913, the property and franchises of the eight following companies:

Name.	Date of in- corporation.	Incorporated for.
Westmoreland W. Co. of Unity Township,	1886	Unity Township.
Westmoreland W. Co. of Hempfield Township, ..	1886	Hempfield Township.
Derry Water Company,	1887	Derry Borough.
Westmoreland W. Co. of Greensburg Borough, ..	1886	Greensburg Borough.
Irwin Water Company,	1889	Irwin Borough.
Penn Borough Water Co.,	1887	Penn Borough.
Penn Township Water Co.,	1887	Penn Township.
North Huntingdon Water Co.,	1887	North Huntingdon Township.

The system of the Derry Water Company is separate from the others and hence it is not described.

The Standard Water Company, incorporated in 1900, for Unity Township, by the H. C. Frick Coke Company, furnishes an industrial supply at Pleasant Unity village.

The Consumers' Water Company of North Huntingdon Township, incorporated in 1900, for said township by the Westmoreland Coal Company, furnishes an industrial supply at Westmoreland City village.

The North Irwin Water Company incorporated in 1895, for North Irwin borough, is owned by the Carruthers Estate in Irwin borough.

General Description of Westmoreland Water Company System.

Source and Collection.

(1) Nine Mile Run and its tributary, Armel Run, are in the Loyalhanna Creek basin. Immel Reservoir, capacity 170,000,000 gallons, is an earthen embankment structure built near the head waters of Nine Mile Run near the foot of Chestnut Ridge Mountain, 5 miles south of Latrobe, and 9 miles southeast of Greensburg, at an elevation of 1,422 feet above mean sea level. The watershed of Nine Mile Run tributary to Immel Reservoir, is 0.5 square miles. This area yields an average daily flow, determined by measurements covering a period of 5 years, of 378,920 gallons. Immel Reservoir also receives the discharge of an 18 inch pipe line from an intake dam on Armel Run, 5,000 feet east of the reservoir. The watershed above this intake has an area of 1.45 square miles. The average daily flow or yield from this area at the intake is 1,142,240 gallons for a five year period.

(2) Sewickley Creek, a tributary to the Youghiogheny River, has a watershed of 0.90 square miles above an intake which is 6,000 feet southwest of Immel Reservoir. From this intake there is a 16-18 inch pipe line which delivers into the Immel Reservoir an average daily flow of 981,980 gallons, as observed for 5 years.

(3) Township line or Smail's Run, a tributary of Sewickley Creek, has built on it, near its head waters, an impounding dam or reservoir known as Unity Reservoir. The elevation at high water is 1,280 feet and the storage capacity is 465,000,000 gallons. The watershed above this dam is 450 acres only. The average daily yield from this area, as determined for a 5 year period, was 600,000 gallons. The water is pumped from this reservoir through a 14 and an 18 inch force main into Dry Ridge distributing reservoir, capacity 2,000,000 gallons, located a quarter of a mile west at elevation 1,300. The pumping equipment consists of a 3,000,000 gallon Worthington Pump and one 30 H. P. boiler.

(4) By an agreement with the Mountain Water Supply Company, controlled by the Pennsylvania Railroad Company, which agreement was signed in the year 1910, the Westmoreland Water Company is allowed a certain maximum and minimum daily amount of water from Indian Creek to be paid for at a certain rate because of rights which the said Westmoreland Company has on Indian Creek. At the present time the water is taken from the 30 inch main of the Pennsylvania Railroad Company at South Greensburg and is there raised through a booster pumping station.

The said agreement is dated April 27th, 1910, and is between the Mountain Water Supply Company and the following companies:

The Westmoreland Water Company of Hempfield Township,
The Penn Borough Water Company.
The Penn Township Water Company.

The North Huntingdon Water Company.

The Westmoreland Water Company of Unity Township.

The Westmoreland Water Company of Greensburg Borough.

The Westmoreland Water Company of Ludwick Borough.

The Irwin Water Company.

At that time the Mountain Water Supply Company, pursuant to condemnation proceedings heretofore had, by which it claimed to have secured the right to take and appropriate for the purposes of its incorporation all the waters of Indian Creek which flows through Fayette County and empties into the Youghiogheny River in Springfield Township, said County, had erected on said creek a large dam and reservoir and had laid a line of pipe for the transportation of the waters of said creek from the reservoir to a point near or at Ruth Station on the line of the Pennsylvania Railroad Company, which said line of pipe extends along the railroad into Westmoreland County and the Mountain Water Supply Company was selling and intended to continue selling the water of Indian Creek through and by means of the aforesaid dam and pipe line to the said railroad company.

And whereas, the said eight water companies by virtue of condemnation proceedings instituted by them, also claimed to secure the right to take and claim for their uses all the waters of said Indian Creek in opposition to the claim or right asserted by the said supply company, and there was pending in the Court of Common Pleas of Fayette County, proceedings in equity, instituted by each of the said eight water companies against the supply companies, it was agreed to avoid further controversy and to terminate the litigation by a written contract. Said agreement of April 27th, 1910, providing substantially as follows:

First: That for the term ending December 31st, 1934, the Supply Company will furnish and deliver to the water companies in the manner and at the places hereinafter mentioned, and the water companies will take water from said Indian Creek to an amount per day to be designated from time to time by the water companies, which, however, shall not be less than, nor greater than the minimum and maximum amounts specified in the following table:

Amounts in One Thousand Gallons.

Years.	Daily Minimum.	Daily Maximum.
1910.	200	1,000
1911.	250	1,000
1912.	300	1,000
1913.	350	1,000
1914.	400	1,000
1915.	500	1,000
1916.	625	1,250
1917.	750	1,500
1918.	875	1,750
1919.	1,000	2,000
1920.	1,125	2,250
1921.	1,250	2,500
1922.	1,375	2,750
1923.	1,500	3,000
1924.	1,625	3,250
1925.	1,750	3,500
1926.	1,875	3,750
1927.	2,000	4,000
1928.	2,125	4,250
1929.	2,250	4,500
1930.	2,375	4,750
1931.	2,475	4,950
1932.	2,575	5,150
1933.	2,675	5,350
1934.	2,775	5,550

Second: The water to be furnished shall be delivered to the water companies through the mains of the supply company and the line of pipes owned by the Pennsylvania Railroad Company, and in order to enable such deliveries to be made, connections shall be made between the said line of pipe of the Pennsylvania Railroad Company and the lines of pipe of the water companies at the following points, all in Westmoreland County:

North of Depot Street in the borough of Youngwood, Hempfield township, by an 8 inch connection;

At or near County Home, in said Hempfield township, by a 12 inch connection;

At or near Jeannette Reservoir, in said Hempfield township, by a 12 inch connection;

At or near Race Street, in the borough of Manor, Penn township, by an 8 inch connection;

At or near the bottom of Main Street in the borough of Irwin, by an 8 inch connection.

Third: The cost of making the connections is to be borne by the water companies.

Fourth: Meters to measure the water delivered by the supply company to the water companies are to be provided, erected and maintained by the supply company.

Fifth: The deliveries of water shall be by gravity and under such working pressure as is available and results from existing levels for the time being of water in the reservoirs from which the water so delivered is drawn, and the friction in the pipes of the supply company and of the said Pennsylvania Railroad Company, and as such pressure may be affected or diminished by the delivery of water for the uses and needs of the said railroad or of other consumers thereof.

Sixth: The supply company is to receive payment at the rate of eight cents per 1,000 gallons for the water delivered to the water companies.

Seventh: If the water companies shall give notice in writing of their desire to extend the terms of the agreement for a further period of 25 years, from and after December 31, 1934, the supply company is obligated to furnish and deliver the water until December 31st, 1959, subject to the terms and conditions as hereinbefore mentioned, except there shall be an increase in the daily quantities. However, the supply company may elect to make delivery of water to the water companies at the present existing dam on Indian Creek, in which event, the water companies shall lay such lines of pipe as may be necessary to enable them to receive the deliveries at said dam and the price of the water, so delivered may be determined by a board of arbitrators.

Eighth: The water companies shall be entitled to not exceeding one half the water that may be secured through or by means of the construction of reservoirs sufficient to retain and hold the waters of Indian Creek that can be secured and developed through and by means of storage, the price to be determined by arbitrators.

Ninth: Under certain conditions the water companies may construct reservoirs of a size and capacity not greater than is requisite to enable them to take one-half of the amount of water of Indian Creek of the character referred to.

Tenth: The supply company agrees to purchase and the water companies to sell all lands abutting on or adjacent to Indian Creek, amounting to about

600 acres for the price of \$2,500, but reserving their claim to the exercise of the right of eminent domain of the waters of Indian Creek.

Eleventh: The supply company and the water companies will join and co-operate in taking all steps that may be advisable or necessary to prevent the diversion by any other person or corporation, of the waters of Indian Creek or of its tributaries, or the pollution of the same, or to prevent any other interference with the rights and interests of the said supply and other companies.

(5) Another source of supply of the Westmoreland Water Company is Jeannette Reservoir, capacity 75,000,000 gallons, in a valley of a small run, 2.5 miles west of Greensburg, said run being a tributary of Brush Creek near Jeannette. The water shed area is 0.323 square miles. Several springs feed the reservoir; but the stream itself is diverted to pass around the reservoir.

Distribution.

(1) By gravity through 16-18 main into Immel Reservoir.

(2) By gravity through 14 inch pipe line from Immel Reservoir northwest, 9 miles, passing Unity Reservoir and connecting to Dry Ridge distributing reservoir. A 6 inch branch extends through Whitney.

(3) By gravity through 18 inch main west 2.5 miles to South Greensburg with 8 inch line south 3 miles to Youngwood; and through 12 inch main northwest 2.5 miles to Greensburg. A 12 inch line connects South Greensburg to Greensburg and thence to Jeannette Reservoir.

(4) From connection at Huff, a 14 inch main extends northwest 3 miles to Jeannette Reservoir.

(5) By gravity through 14 inch main from Jeannette Reservoir, extending through Jeannette, reducing to a 12 inch through Penn and a 10 inch through Manor and Westmoreland City, and connecting at Irwin with a 1,400,000 gallon distributing reservoir.

The Unity pumping station is a frame building on stone foundation with slate roof, having one 3,000,000 gallon Worthington pump and one 30 H. P. boiler. The booster station for the Indian Creek supply in South Greensburg is a brick building with concrete foundation and basement and a slate roof. It houses two 8 inch DeLaval, two stage centrifugal pumps, capacity 1,300 gallons per minute each. Also two 75 H. P. Westinghouse motors.

The length and size of supply mains in the entire system (excluding distributing mains) are as follows:

Size.	6 in.	8 in.	10 in.	12 in.	14 in.	16 in.	18 in.	Total.
Length,	6,100	7,200	14,500	18,900	61,450	6,350	22,600	137,100

In the Greensburg district, including Greensburg, Southwest Greensburg, South Greensburg and Youngwood, the distributing mains total 255,291 feet or 48.3 miles. The approximate length of each size (exclusive of supply mains) is as follows:

Size.	1½ in.	4 in.	6 in.	8 in.	10 in.	12 in.	Total.
Length,	19,366	86,130	87,580	38,940	4,990	18,285	255,291

In the Greensburg District there are 208 hydrants, all of which have 6 inch barrel. The pressures in the mains range from 35 lbs. to 140 lbs. The topography is hilly. The elevations in the built-up sections range from 1,000 to 1,227 in Greensburg and from 965 to 1,050 in Youngwood. In this district the Jamison Coal and Coke Company are customers.

In the Jeannette district, including Jeannette, Penn, Manor and Westmoreland City, the distributing mains total 121,289 feet or 22.97 miles. The approximate length of each size (exclusive of supply mains) is as follows:

Size.	2 in. and under.	4 in.	6 in.	8 in.	10 in.	12 in.	14 in.	Total.
Length,	12,650	44,790	30,765	10,150	8,084	10,060	4,790	121,289

In the Jeannette district there are 58 hydrants, all of which have 6 inch barrel. The pressures in the mains range from 20 lbs. to 110 lbs. The topography is hilly. The elevations range from 965 to 1,240.

In the Irwin district, including Irwin and North Irwin, the distributing mains total 47,355 feet or 8.97 miles. The approximate length of each size, (exclusive of supply mains) is as follows:

Size.	2 in. and under.	4 in.	6 in.	8 in.	10 in.	Total.
Length,	6,825	20,005	13,520	5,455	1,540	47,355

In the Irwin district there are 26 hydrants, all of which have 6 inch barrel. The pressures in the mains range from 20 lbs. to 110 lbs. The topography is hilly. The elevations range from 880 to 1,120.

Consumption.

For the Greensburg district the company reports an average daily consumption for the year 1913, of 970,000 gallons of which 27% was domestic and 73% industrial as determined by meters. The company also reported 3,953 taps all metered, of which 10% are industrial. The Commission's auditor reported that from the books there was an average daily consumption for 1913, of 995,000 gallons and that the metered connections totaled 4,007. Furthermore, the company reported that the industrial consumption was 708,000 gallons daily and the domestic consumption 262,000 gallons daily. The estimated population is 24,000.

For the Jeannette district the water company reported that the average daily consumption for 1913, was 419,000 gallons of which 25% was domestic and 75% industrial. This was ascertained from the meters. The company further reported that there were 1,925 taps of which 1,836 were metered, five per cent of the metered taps being industrial. The industrial consumption was 314,000 gallons daily and the domestic consumption 105,000 gallons. The estimated population is 13,000.

The Commission's auditor reported that from the books the average daily consumption for 1913, was 450,000 gallons and that the number of taps totaled 2,206.

For the Irwin district the company reported that the average daily consumption for 1913, was 144,000 of which 30% was domestic and 70% industrial.

There were 663 taps all metered of which 14% were industrial. The industrial consumption was 100,800 gallons daily and the domestic consumption 43,200 gallons daily. The estimated population supplied was 4,000.

From the books the Commission's auditor ascertain that the average daily consumption in this district was 148,000 gallons and that the number of taps was 7,591, all metered.

The maximum consumption of the entire water works system for any single day is reported to be about 3,000,000 gallons. The average daily consumption, including all of the coke ovens and coal operations and rural districts, both metered and unmetered, is said to be approximately 2,000,000. We do not have accurate figures at the present time of this consumption nor of the entire population in the water district.

Condition of Plant.

The Immel reservoir is not absolutely water tight. A considerable leakage which occurred several years ago has been stopped.

It has been calculated that during the wet months of the year more than 100,000,000 gallons of water go to waste. It was intended to collect this overflow water in the Unity reservoir. The Unity reservoir has a very small watershed of its own. It was the intention when this great storage basin was constructed that it should be filled from the mountain watershed by the water which now escapes as overflow. However, the 14 inch pipe line is not of sufficient capacity to deliver the surplus mountain water to the Unity reservoir and at the same time furnish water to the consumers in the district. If the surplus water which runs off from the Chestnut Ridge area were to be collected and delivered into Unity, then a larger and parallel gravity supply main would have to be built. The cost would be considerable. There is another way in which this surplus water from the mountain could be secured, and utilized in the water district, namely by installing a booster pumping station on the line. This would mean that for three or four months all of the mountain water would have to be pumped through the gravity main; in fact at the present time, all of the water during dry seasons supplied in the entire district has to be pumped, after Immel supply has been depleted. When Immel reservoir is filled, it feeds water by gravity into Dry Ridge distributing reservoir at the other end of the gravity line and from there water can be supplied to Greensburg by gravity. However, the Indian Creek supply has developed and its use requires pumping. It should be noted that a certain minimum amount of water at 8 cents per thousand gallons must be paid for whether that minimum quantity of water is used or not. This arrangement, therefore, has been postponed and may altogether prevent the collection of all of the water that is yielded from the said mountain area. Just where the economy in this matter comes has not yet been determined. Unity reservoir is never filled. When the water gets up to some 35 feet or more elevation, a leak through the dam or under the hill forming the reservoir is developed; but in 1913, or thereabouts, obstructions to this leakage were created by making borings and grouting the same which operated to cut off such leakage to some extent, and it is reported that this remedy is considered effectual. Whether this is a fact or not is doubtful.

The Indian Creek supply at no great future date may have to be filtered. This will be an additional expense. Besides improvement to the distributing system with respect to better fire service will have to be made, and probably as the investigations proceed, other expenditures of money will be found necessary to bring the plant up to its most efficient state. At the present moment it would appear that the greatest expenditure of money for any one thing will be the filtration of the Indian Creek water.

The records have not been examined as yet to determine whether water borne diseases have been prevalent during the time that Indian Creek water has been supplied to the consumers of the Westmoreland Water Company. However, at Scottdale borough, where the public receives Indian Creek water through a subsidiary of the Mountain Water Supply Company, or this company directly, there have, on several occasions, been typhoid fever epidemics, attributed by the people to Indian Creek water. The Commissioner of Health has had a sanitary survey made of Indian Creek water shed and has attempted to remove all sources of pollution of the water thereof. An inquiry is now being conducted by the State Department of Health into the question of the purity of Indian Creek water and the necessity for filtering it, with the probability that the Commissioner of Health will enjoin upon the water company the cost of erecting and operating a filtration plant for the treatment of the Indian Creek water. It seems pertinent to bear this possibility in mind since such an enforced capital investment would have some effect upon the gross annual revenue which the Commission is to find and allow to the company on its investment and for operating expenses.

Purity of the Indian Creek Water.

In 1909, during the drouth of that season, the Westmoreland Water Company of Hempfield Township, had up with the State Commissioner of Health, the question of the quality of the water in Jeannette reservoir. It was on and about this time that the Pennsylvania Railroad Company was temporarily supplying water from the Indian Creek pipe line to the citizens in Greensburg. On December 27, 1909, the State Commissioner of Health issued a decree to said water company requiring it to consider plans for some other and abundant supply of pure and wholesome water as an addition to its existing source of supply. This was done and on January 10, 1910, the Westmoreland Water Company of Unity Township, the Westmoreland Water Company of Hempfield Township, the Westmoreland Water Company of Greensburg borough and the Westmoreland Water Company of Ludwick borough, the Penn Township Water Company, the Penn Borough Water Company, the North Huntingdon Water Company and the Irwin Water Company made a joint application to extend their water works for the supply of water to the public within Greensburg, Southwest Greensburg, South Greensburg, Youngwood, Hempfield Township, Jeannette, Penn, Penn Township, Manor, North Huntingdon Township, Irwin and North Irwin, Westmoreland County, and to obtain an additional source of supply from Indian Creek through contract with the Mountain Water Supply Company. In the application the said companies represent as follows:

"That eight water companies, namely, The Westmoreland Water Company of Unity Township, the Westmoreland Water Company of Hempfield Township, the Westmoreland Water Company of Greensburg borough, the Westmoreland Water Company of Ludwick Borough, the Penn Township Water Company, the Penn Borough Water Company, the North Huntingdon Water Company and the Irwin Water Company, supplying the communities of Greensburg Borough, Southwest Greensburg Borough, South Greensburg Borough, Youngwood Borough, Jeannette Borough, Penn Borough, Manor Borough, Irwin Borough, North Irwin Borough, and portions of Unity, Hempfield, Penn and North Huntingdon Townships, Westmoreland County, and needing additional water the said eight companies on April 27th, 1904, duly appropriated the waters of Indian Creek, situated in Fayette County and, after being delayed by litigation, contracted with the Mountain Water

Supply Company on April 27th, 1910, for the transportation of said Indian Creek water, copy of said contract being filed with your Department June 2nd, 1910. Said eight above named companies have the same president and secretary."

"Wherefore, the said authorities, showing that the proposed source of supply appears not to be prejudicial to the public health, respectfully pray that a permit be issued for said additional supply as aforesaid."

Up to the present time action has been deferred on this application by the Commissioner of Health. The chemical treatment of the water at the Indian Creek reservoir has been effected by apparatus approved by the State Department of Health. To install a filter plant at Indian Creek to filter 8 or 10 million gallons of water, involves a very large expenditure of money. The public at Scottdale and the public in the district of the Westmoreland Water Companies, are the only people receiving and using Indian Creek water for domestic purposes. It has been thought that possibly a filter plant at Scottdale and another filter plant at Greensburg wherein over one-third of the water from Indian Creek could be filtered, would answer the purpose. If this should be decreed during this rate case before the Public Service Commission, or immediately thereafter, it would put a considerable cost for investigation and operation upon the Westmoreland Water Company that would have to be considered and would be reflected in the rate schedule.

First Engineers' Conference.

After Chief Joyce of the Bureau of Accounts and Statistics had made an examination of the books and accounts of the water company and submitted a report, I took up with the attorneys the matter of the engineers conferring at Greensburg and the conditions under which the conference was to proceed were defined in a letter written by Messrs. Gaither and Whitten to me, and submitted to and approved by the Commission. These conditions were as follows:

- a—To agree, so far as possible, upon the location, kind and amount of the respondent's property, without regard to the value thereof. This seems to be purely a question for engineers.
- b—To agree so far as possible, upon the original cost of the respondent's property; and for that purpose both petitioner and respondent are to furnish, each to the other, all information in the position of either, touching the cost of the different portions of such property.
- c—To agree, so far as possible, on the cost of reproduction new, and perhaps cost of reproduction new less accrued depreciation of the respondent's property.

It must be clearly understood that no estimate as to any of the above mentioned matters shall be binding upon either party, unless the engineers representing the petitioner, the engineer for the respondent and the engineer representing the Commission shall all concur therein. All matters not so agreed upon shall be left open to be determined by the Commission, upon testimony taken at public hearings to be held for that purpose.

This first conference of the engineers was held at Greensburg, March 10th to the 13th inclusive.

At this conference the inventory of the property as of July 1st, 1914, was agreed to and signed by C. W. Knight, engineer for the petitioner, Morris Knowles, engineer for the respondent, and Mr. Snow, engineer for the Commission. The inventory did not contain an item for rock encountered in the distribution system.

At the conference the following original cost items of the tangible property of the Westmoreland Water Company to July 1st, 1914, as determined by an examination of the books and accounts of the company by Mr. Joyce were reviewed and agreed to and signed by Messrs. Knight and Muse for the petitioners. Knowles and Scharff for the respondents and Joyce and Snow for the Commission:

Construction.

Cost of original construction as shown by books of the Delaware Company, July 10th, 1888 to May 31st, 1894,	\$309,253.11
Cost of Original construction as shown by the Irwin Company (Irwin Water Company),	21,480.29
Expenditures for additions and betterments, March 1st, 1890, to July 1st, 1914,	693,173.45
Total,	<u>\$1,023,906.85</u>

Real Estate.

Cost of original construction as shown by books of the Delaware Company, July 10th, 1888 to May 31st, 1894,	\$14,955.43
Original construction, Irwin Water Company,	1,906.04
Additions and betterments, March 1st, 1890 to July 1st, 1914,	59,449.94
	<u>\$76,311.41</u>

Grand total, \$1,100,218.26

Reservations were made by respondent's engineers relevant to both construction and real estate items, all of which are given in detail in my report to the Commission, dated April 19, 1915. This report also gives in detail the inventory agreed to.

Second Engineers' Conference.

The second engineer's conference was held at Greensburg March 23rd, to the 26th, inclusive. At this meeting Mr. H. Dallas McCabe, representing the borough of Jeannette, intervening petitioner, was admitted to the conference by and with the consent of the engineers and attorneys representing the petitioners and the respondents. At this second meeting agreements were reached and signed as to the value of certain other items of original cost of the water works, amounting to a total of \$172,721.40, making the total cost of a water works as agreed to \$1,272,939.66.

Items of discounts, commissions and financial expenses involving \$47,650; book cost of the Irwin water works involving \$55,929.00 of which \$24,753.81 was agreed to by the engineers, and discounts less premiums on preferred stock involving \$3,839.66 were left for consideration of the Commission and also three other items, namely, cost of stock issued by Delaware Company for service, etc., cost of rights and interests in Indian Creek and supply of water therefrom and cost of franchises due to supply of free water.

All of which appears in detail in my report to the Commission of April 19, 1915. The stipulations made at this conference and appearing in said report are of importance.

Third Engineers' Conference.

The third engineers' conference was held at Greensburg, April 21st to the 15th inclusive. At this meeting reproduction cost new was taken up and such values were placed upon Sewickley and Armel dam, meters, valves, hydrants, services, crossings, tunnels, miscellaneous property and Unity and booster pumping stations and equipment, totalling \$196,415.10. There were left for the consideration of the Commission, items totalling \$68,480.00, involving part of the services and tunnels, all of which is given in detail in my said report of April 19, to the Commission. The reservations and stipulations made by the various engineers and incorporated in the report are important.

Fourth Engineers' Conference.

The fourth engineers' conference was held at Greensburg on April 23rd to April 26th, inclusive.

At 1:30 o'clock on the afternoon of April 23rd, when all were present, Mr. McCabe on behalf of the petitioners, announced that they were ready to present their total sum of reproduction cost new, and that they would agree to give this total, provided the engineers for the respondent would do the same. It was agreed by the engineers of the conference to adopt the following plan in order that the conference might continue and the engineers for both parties might proceed to take up details and arrive at an agreement as to the differences in the items and totals of the inventory and appraisal as far as this was possible, namely that the inventory as agreed upon, excluding the cost of establishing business should be taken as a guide and that Mr. Knowles for the company should place opposite each item in the inventory the cost per unit and the total cost in dollars, and that Mr. Knight for the petitioners should do the same and both such computations should be placed upon the table at the same time.

The results in total are given in the following tables:

Reproduction Cost New Submitted by Mr. Knowles.

Item.	Cost.
1—Real Estate and Rights of Way (5% for Eng.),	\$118,090.87
2—Sewickley Dam (14% for Eng. Contingencies & Gen.),	2,772.48
3—Armel Dam (14% for Eng. Contingencies & Gen.),	5,244.00
4—Immel Reservoir (14% for Eng. Contingencies & Gen.),	96,281.84
5—Unity Reservoir (14% for Eng. Contingencies & Gen.),	158,717.75
6—Dry Ridge Reservoir (14% for Eng. Contingencies & Gen.), .	16,640.58
7—Jeannette Reservoir (14% for Eng. Contingencies & Gen.),	46,277.22
8—Irwin Reservoir (14% for Eng. Contingencies & Gen.),	16,000.36
9—Supply lines (14% for Eng. Contingencies & Gen.),	378,809.23
10—Distributing Systems:	
Greensburg District,	\$417,680.85
Jeannette District,	179,711.00
Irwin District,	66,240.30
	\$663,632.15
14% add. for Eng. Cont. and Gen.,	92,908.50
Amount forward,	\$756,540.65

Brought forward,	\$756,540.65
11—Unity Pump Station (14% for Eng. Cont. & Gen.),	7,065.95
12—Booster Station (14% for Eng. Cont. & Gen.),	10,902.62
13—Miscellaneous Property,	18,225.00
	<hr/>
14—Working Capital,	\$1,631,568.55
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15—Promotion and Organization (2% on 14-2),	33,031.37
	<hr/>
	\$1,684,599.92
16—Financial Expenses (8% on 15),	134,767.99
17—Interest during construction,	119,129.29
18—Going Cost approx.,	350,000.00
	<hr/>
	\$2,288,497.20
19—Indian Creek rights and contract,	330,000.00
20—Additions to develop full cap. of watershed,	100,000.00
	<hr/>
Grand total,	\$2,718,497.20

Reproduction Cost New Submitted by Mr. Knight.

Item.	Cost.
1—Real Estate and Right of way,	\$70,950.88
2—Sewickley Dam,	2,430.00
3—Armel Dam,	4,600.00
4—Immel Reservoir,	61,726.63
5—Unity Reservoir,	98,814.75
6—Dry Ridge Reservoir,	12,654.70
7—Jeannette Reservoir,	31,077.39
8—Irwin Reservoir,	10,020.96
9—Supply Lines,	294,861.30
10—Greensburg Distributing System,	288,026.03
11—Jeannette Distributing System,	139,253.20
12—Irwin Distributing System,	45,518.06
13—Unity Pumping Station,	6,198.20
14—Booster Pump Station,	9,563.70
15—Miscellaneous,	18,225.00
	<hr/>
	\$1,093,920.80
16—Rock subject to tests being made,	10,000.00
17—Intangibles,	112,330.97
18—Add 550 services at \$10,	5,500.00
	<hr/>
	\$1,221,751.77
Deductions:	
Dry Ridge Tunnel,	\$32,580.00
Unity Reservoir,	50,000.00
Paving in Greensburg,	18,799.52
Paving in Jeannette,	7,024.99
Paving in Irwin,	1,970.61
	<hr/>
	110,375.12
Grand total,	<hr/>
	\$1,111,376.65

It will be noted that the total reproduction cost new submitted by Mr. Knowles was \$2,718,497.20, and that Mr. Knight's total was \$1,111,376.65, a difference of \$1,607,120.55. Of course, such a vast difference would be hopeless to attempt to reconcile since the principle upon which the determinations were reached were not the same. It was evident therefore that all the conference could hope to do from this point on, was to reach an agreement respecting those items upon which a reproduction cost new was based by both parties, involving little or no difference. It should be borne in mind that accrued depreciation was not estimated and applied to any of these costs presented by either party.

The physical items about which there was a disagreement as the total cost of reproduction new, were the five reservoirs, the supply lines, the distribution system and real estate and rights of way.

The difference in dollars of the reproduction cost new, as reported by each party for its physical items amounted to \$314,494.85, distributed as shown in the following table:

Reproduction Cost New of Tangible Property, Without Overheads, as Submitted at the Engineers' Conference.

Items.	Respondent.	Petitioner.	Difference.
Real estate and rights of way,	\$112,467 50	\$70,950 88	\$41,516 62
Immel Reservoir,	84,457 75	61,725 63	22,731 12
Unity Reservoir,	139,326 10	98,814 75	40,511 35
Dry Ridge Reservoir,	14,597 00	12,654 70	1,942 30
Jeannette Reservoir,	40,594 05	31,077 59	9,516 65
Irwin Reservoir,	14,035 40	10,020 96	4,014 44
Supply mains,	332,283 80	294,861 30	37,427 50
Distributing system,	663,632 15	472,797 29	190,834 86
Miscellaneous,	41,016 90	41,016 90	00
	\$1,442,415 65	\$1,093,920 80	\$348,494 85
Deduct,			34,000 00
Comparable difference,			\$314,494 85

The engineers of both parties agreed that the average cost of house service connection was \$10. The respondents included \$34,000 for such service connections in their distribution system cost. The complainants did not include anything for this item. Therefore, \$34,000 should be deducted from the \$348,494.85 to give the true comparable difference which is \$314,494.85.

The conference then proceeded to reach an agreement on as many items making up the above classified totals as was possible and to compromise on other items where there was but a small difference only in estimated costs.

With respect to real estate and rights of way, the conference agreed on five items, leaving 12 items not agreed to, the difference between the two estimates amounting to \$41,516.62 to be heard before the Commission.

With respect to Immel reservoir, the conference agreed on 5 items, compromised on 13 items, leaving 6 items not agreed to, the difference between the two estimates amounting \$22,102.80 to be heard before the Commission.

With respect to Unity reservoir, the conference agreed on two items, compromised on 10 items, leaving 2 items not agreed to, the difference between the two estimates amounting to \$41,275 to be heard before the Commission.

With respect to Dry Ridge reservoir, the conference agreed on 2 items, compromised on 15 items, leaving one item not agreed to amounting to \$1,347.50 in dispute, to be heard before the Commission.

With respect to Jeannette reservoir, the conference agreed on 4 items, compromised on 18 items, leaving 4 items not agreed to, the difference between the two estimates amounting to \$7,859.24 to be heard before the Commission.

With respect to Irwin reservoir, the conference agreed on one item, compromised 13 items, leaving 8 items not agreed to, the difference between the two estimates amounting to \$3,699.52, to be heard before the Commission.

With respect to the supply lines, the conference agreed on 18 items, compromised 2 items, leaving 17 items not agreed to, the difference between the two estimates amounting to \$21,757.50 to be heard before the Commission.

And with respect to the distribution system, the conference agreed on 42 items, compromised on 4 items, leaving 41 items not agreed to, the difference between the two estimates amounting to \$156,268.82 to be heard before the Commission.

By adding these sums of money representing the difference between the two estimates, we shall find that the total of the items of physical property in dispute and left to be heard before the Commission is \$295,827.

We have previously seen, however, that the respondents' reported total reproduction cost new submitted for tangibles and intangibles amounted to \$2,718,497.20, and that the petitioners' total to \$1,111,376.65, or a difference of \$1,607,120.55. Hence we must look to other items than those of physical property about which there is a dispute, to account for this great difference and we shall find it in the overheads. Mr. Knowles for the respondents, as will appear from the above table, found for engineering contingencies and general overheads, working capital, promotion and organization, financial expenses, interest during construction, going cost, Indian Creek rights and additions to watershed development, an estimated reproduction cost of \$1,276,081.55, which added to his reproduction cost new of the physical items, gives a grand total of \$2,718,497.20; and we shall see that Mr. Knight, for the petitioners, had for intangibles, rock and service connections, \$127,380.97 and deducted for certain items enumerated in the above table \$110,375.12, making a real addition to his estimate for the physical items of property \$17,455.85, giving his grand total of \$1,111,376.65. Hence over \$1,250,000 in dispute is with respect to overheads and intangibles.

Fifth and Last Engineers' Conference.

The fifth and last engineers' conference was held at Greensburg on May 14th and 15th, 1915. At this conference, Mr. Knowles for the respondents submitted a statement of the cost of establishing business, prepared on tabulation sheets entitled "Westmoreland Water Company Cost of Development, Based on Original Cost." Computed on the basis of a 6% return on investment, 7% return and 8% return, the cost of establishing business was shown to be:

6% =	\$34,329.72.
7% =	506,865.14.
8% =	1,099,896.63.

The engineers for the petitioners refused to agree to any addition to capital on account of establishing business. The position said engineers took was that the plant has not been in operation for 20 years during which period the respondent has fixed the rates to consumers without challenge from any source. The law presumes that the yearly deficit, if any, has been made up by later surplus.

Mr. McCabe on behalf of the petitioning engineers, presented a written statement about the cost of establishing business and among other things in said statement appears the following paragraphs:

"The petitioners, having been denied and still being denied access to the books and accounts of the respondent, are unable at this time to submit any calculation touching such deficit and surplus accounts. However, as evidence of their desire to aid the Commission in making this investigation, engineers for petitioners suggest the following statement as illustrating how the deficit and surplus account might have been kept."

(Tabular Statement Omitted.)

"The data which has been used in making up the above 'statement' is taken from a 'sheet' furnished by Chief Accountant Joyce, as taken by him from respondent's books and entitled:

"Westmoreland Water Company and Irwin Water Company Combined Presented at Greensburg Conference April 28th, by Chief Accountant Joyce."

"Petitioners hereby stipulate that they deny the accuracy of all the items contained in the respondent's books, as shown by the said 'sheet' so as aforesaid furnished by Chief Accountant Joyce and especially the items under column '2' operating expense' for the reason that such expenses are greatly in excess of the amounts which could reasonably be expended for that purpose.

"Petitioners especially stipulate that the above 'statement' shall not be offered before the Commission as proof of any fact in the case; and if the Commission shall determine that a calculation of such deficit and surplus account be made, petitioners reserve the right to examine the respondent's books and accounts, and to take testimony in relation thereto, for the purpose of ascertaining all the facts necessary to make a correct statement of such deficits and surplus account."

At this juncture in the proceeding of the conference, the attorneys on both sides appeared and the attorneys for the petitioners expressed the intention of withdrawing their engineers from further participation in the conference. Said attorneys stated that they were in the dark and not in such mastery of the case as their clients had a right to reasonably expect because they are deprived of the information in the possession of Mr. Joyce which he is not at liberty to reveal under the ruling of the Commission, but which information will become available to both sides when it is made a matter of record at the forthcoming hearing on July 6th. Therefore, until July 6th, the attorneys for the petitioners will not be in possession of requisite data for the preparation of their case, and the engineering conference having accomplished, so far as the petitioners are concerned, all that it was intended to accomplish without access to the books and accounts of the company, or the result of the work of their examination by the auditor of the Commission, said attorneys made it clear that they wanted the conference closed and the conference was adjourned at 4 P. M., May 15th, 1915.

APOLLO AND LEECHBURG WATER WORKS COMPANIES.

The Public Service Commission gave a hearing in Harrisburg to the parties in this case on October 30th, 1914, and on November 17th, 1914. At the later hearing it appearing that there were so many engineering questions involved and such a mass of data to be presented relating to the inventory and appraisal and to the facilities and service of the two water works systems, that it would effect a saving of time to all parties concerned if their engineers were to meet with the engineer of the Commission and endeavor to reach an agreement respecting these matters. Consequently, it was arranged that this should be done and the Chief of the Bureau of Engineering of the Commission was instructed to call such a conference and to preside at the same.

This case involves charges for public fire service in the borough of Apollo and in the borough of Leechburg. The question of hydrant charges is not a new one in these municipalities. There has been litigation in the past brought by each municipality independently, and in the case of the borough of Leechburg vs. Leechburg Water Works Company, it reached the Supreme Court of Pennsylvania.

Before proceeding to report the work of the engineering conferences a description of the territory served and the water works systems serving the public therein and a history of prior litigation will be given:

Apollo Borough.

The borough of Apollo was incorporated under a special act of the Legislature approved March 15th, 1848, and on December 9, 1873, became subject to the provisions of the General Borough Act of April 3rd, 1851.

Apollo borough is situated in Armstrong County, on the Kiskiminetas River and has a population of about 3,000.

The population by decades, U. S. Census:

1890—2,156.

1900—2,924.

1910—3,006.

The borough has mining and manufacturing interests, and is growing more rapidly at the present time than it was ten years ago.

It covers an area, quite thickly settled of 4,000 feet along the river and 3,000 feet back therefrom on the hills. The buildings are principally of wood and some brick two to three stories in height. The local authorities report the assessed valuation to be

1910—\$480,750.

1912— 492,730.

1913— 617,850.

1914— 643,081.

The county commissioners acting as a board of revision, can decide that the assessments are so low or so high, as to work an injustice upon other districts in the county and increase or diminish the same for county purposes and state purposes. This county assessment is not based, as required by law, upon prices at which the properties would sell, after reasonable notice at a bona fide sale, but, according to the uncontradicted testimony produced at the

hearings before the commissioners and admitted by counsel for complainants, such assessment at present is one-third of the value at which the property should be legally assessed. The real assessable value of the taxable property in the borough of Apollo is at least \$1,800,000.

The Apollo Water Works Company was incorporated April 25th, 1884, capital stock \$10,000, under the General Corporation Act of April 29th, 1874 for the purpose of supplying water to the inhabitants of Apollo borough and vicinity, and is amenable to the Public Service Company Law.

On March 3rd, 1888, the borough of Apollo, by ordinance granted to the company the right to lay necessary pipes and lines in the streets and alleys and pursuant thereto, the company erected and constructed a water works plant for the purpose of supplying water to the territory. This plant consisted of a pump located on the Kiskiminetas River, a short distance above the built-up part of the borough of Apollo, by which water was raised through a force main to reservoir tanks (wood) situate on the hill back of said borough and from whence it flowed by gravity through the distributing pipes laid in and under the streets and alleys of said borough. In the construction of this plant, the Apollo Water Works Company expended about \$20,000. The total value of the plant was reported in 1906 to be \$28,400. The water supply in 1890 was taken from the Kiskiminetas River and the water was furnished to the consumers in its natural and unfiltered conditions.

In 1888 a contract was entered into between the borough of Apollo and the Apollo Water Works Company by which said company agreed for a term of five years, with right to renew for five years additional, to furnish all water needed for fire protection (the number of fire hydrants set by the borough to be unlimited) for the sum of \$500 per annum. It is claimed by the borough that the agreement, under the renewal clause, was not extended but the company up to July 1903, did supply water to the borough hydrants for \$500 per annum, when upon said date the Apollo Water Works Company served notice on the borough of Apollo of an increase in rate for fire protection. The Court of Common Pleas of Armstrong County fixed the reasonable rate and charge for use of water for fire protection in Apollo and issued a decree in relation thereto on June 20, 1904.

In the years 1900 and 1901 and for sometime prior thereto, the waters of the Kiskiminetas River became so contaminated with sulphuric acid from coal mining and manufacturing operations that the water was totally unfit for use for domestic and commercial purposes. A public indignation meeting of the citizens was called by the Burgess of Apollo and was held October 6th, 1900. Arrangements were there made for appeal to the Courts for relief. The said Apollo Water Works Company as a result of such pollution and contamination of the waters of the said river, and of such protest was compelled to seek elsewhere for an adequate and sufficient water supply for Apollo.

Leechburg Borough.

The borough of Leechburg was incorporated under a special act of the Legislature approved March 22d, 1850, and became subject to the provisions of the General Borough Act of April 3d, 1851. Leechburg is situate in Armstrong County on the Kiskiminetas River, about six miles down stream from Apollo borough and has a population of about 3,600.

The population as per the U. S. Census has been as follows:

1880—1,123.
1890—1,921.
1900—2,459.
1910—3,624.

The borough has a number of mining and manufacturing interests, and is growing both in wealth and population. It covers an area of about one-half mile by 0.5 miles. The buildings are principally of wood and brick, two and three stories high. The local assessors of Leechburg borough fixed the assessed valuation of taxable property in 1906 at \$441,940.00. The county commissioners increased the same for county purposes 20 per cent., adding \$70,-422.00, making the total assessment for county and state purposes, \$512,362.00.

In 1910—assessed valuation, \$567,258.00.

In 1911—assessed valuation, \$524,025.00.

In 1912—assessed valuation, \$586,628.00.

In 1913—assessed valuation, \$673,367.00.

In 1914—assessed valuation, \$674,093.00.

It was admitted by counsel before the Public Service Commission that the assessment is only about one-third of the value at which the property should be legally assessed. The real assessable value of the taxable property in Leechburg is at least \$2,000,000.00.

The Leechburg Water Works Company was incorporated December 18th, 1882, capital stock, \$15,000.00, under the general corporation act of April 29th, 1974, for the purpose of supplying water to the inhabitants of Leechburg borough and vicinity.

On April 30th, 1888, the borough of Leechburg by ordinance granted the company permission to lay its pipes in the streets and highway of the town, and in pursuance thereto the company erected and constructed a water works plant for the purpose of supplying water to the territory included in its charter. The plant consisted of a pump located on the Kiskiminetas River, a short distance above the built-up part of the borough, by which water was raised through a force main to wooden reservoir tank situated on the hill back of said borough, and thence flowed by gravity to and through the distributing pipes laid in and under the streets and highways of said borough. In the construction of this plant the Leechburg Water Works Company expended about \$20,000. The total reproduction cost new of the plant in 1906 was determined to be \$22,950.00. The water supply was taken from the Kiskiminetas River and furnished to the consumers in its natural and unfiltered condition.

Shortly after the installation of this plant, a contract was entered into between the borough of Leechburg and the Leechburg Water Works Company by which said company agreed for a term of years to furnish water to said municipality for public fire protection for the sum of \$500.00 per annum. A subsequent contract was entered into for a term of five years from August 22d, 1896, to August 22d, 1901, at the same annual rate. It was claimed by the borough that under the renewal clause this agreement was extended from August 22d, 1901, to August 22d, 1906. This was denied by the Water Works Company. But in any event it is conceded by all parties that what ever contract relations may have existed between the water company and the borough prior to August 22d, 1906, the same were at an end and fully determined at that date.

All of the capital stock, physical plant and franchises of both the Apollo Water Works Company and the Leechburg Water Works Company are held and owned by the Pennsylvania Water Company, another Pennsylvania corporation, having the power and authority to own said stock, and while it is true that both the Apollo Water Works Company and the Leechburg Water Works Company are operated separately directors, and officers, both of said companies are owned by the said Pennsylvania Water Company.

Joint Supply Plant.

The Apollo Water Works Company and the Leechburg Water Works Company being forced to abandon the supply of water previously obtained from the Kiskiminetas River, carefully examined the various streams and water courses in the vicinity of both boroughs, and concluded that the most practicable permanent and sufficient supply of water for both municipalities could be procured from a joint impounding and filtration plant to be erected in Beaver Run in Westmoreland County, distant about a half mile from the borough of Apollo and about four and a half miles from the borough of Leechburg. It was found after estimates had been made that such joint impounding and filtration plant could be erected and operated at a very considerable saving in cost over the amount required to construct, equip and operate separate plants for each of said boroughs.

The two water companies, in order to provide for a permanent, adequate and sufficient supply of water for the said two boroughs, and to comply with the legal requirements and obligations incident to the incorporation and existence of said companies as public service companies, in discharging their duties imposed of furnishing an adequate and sufficient supply of water of a reasonable quantity and quality, pure and wholesome, for domestic and commercial use, in 1900 and 1901 purchased some 50 acres of land on Beaver Run, Westmoreland County, Upon the site a short distance above the confluence of said run with Kiskiminetas River, distant about a half mile from Apollo Borough, and four and a half miles from Leechburg Borough, said Apollo Water Works Company and Leechburg Water Works Company constructed a complete water works plant, consisting of an impounding reservoir, public plant and filtration beds. From this Beaver Run plant the water was pumped to a distributing reservoir situated on the Owens farms in Allegheny Township, Westmoreland County, distant about one mile from Apollo Borough, and three and a half miles from Leechburg Borough. From this distributing reservoir the water is conducted through supply mains to the borough of Apollo and Leechburg.

The Apollo Water Works Company and the Leechburg Water Works Company expended on the construction of their joint Beaver Run plant, including the Owens reservoir, \$134,842.91, so it was reported. This was the actual cost, so reported, of the physical plant to which was added interest during construction on \$50,000 or \$3,000, making the total cash investment in this joint Beaver Run Plant \$137,842.91. That with the present advance in price of material and labor it would cost today considerably more than the amount named to duplicate or replace this work of the plant. The present cash value of the plant, allowing for depreciation, and taking into consideration advance in the cost of materials and labor, would undoubtedly exceed the sum of \$137,842.91.

The two boroughs of Apollo and Leechburg are practically equal in size, population, value of taxable property, consumption of water, number of consumers and total revenue paid to said companies, so that in estimating the actual cash investment of each company in this joint impounding, filtration and reservoir plant, half the cost thereof was charged to each company. Hence it was stated in 1905 that the Apollo Water Works Company has, therefore, invested and the cash value of this portion of its plant as constructed in 1906 was \$68,921.46, and the same, \$68,921.46 for the Leechburg Water Works Company.

From the 12 inch force main leading from the pumping station to Owens reservoir, at a point opposite Apollo, water is conducted to the borough of Apollo through one 12 inch supply main, and a double line of 10 inch pipe under the river and distributed to the inhabitants through a system of 8 inch,

6 inch, 4 inch, 3 inch, 2 inch and 1 inch pipes laid in the streets and alleys of the towns. In the supply line from the force main to the borough of Apollo, the Apollo Water Works Company had invested in 1906 as reported then, \$3,964.50. In the distributing pipes in the borough of Apollo including service lines and laying \$28,400.00. To this should be added \$6,000.00, the value of the Apollo plant as a "going business" at the time of its purchase by the present company, making the total investment of the Apollo Water Works Company as constructed and valued in 1906 in the borough, \$38,364.50, as follows:

Cost of distributing pipe in Apollo, etc.,	\$28,400.00
Cost of supply main,	3,964.50
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Cost of work,	\$32,364.50
Going value,	6,000 00
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Apollo supply line and distribution,	\$38,364.50

So the total cash value of the Apollo Water Works plant exclusively used in Apollo borough in 1906 was as follows:

Half cost of Beaver Run plant including Owens reservoir,	\$68,921.46
Apollo supply line and distribution,	32,364.50
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Total cost,	\$101,285.96
Going value,	6,000 00
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.	\$107,285.96

From the "T" connection 727.5 feet from the Owens reservoir water is conducted to the borough of Leechburg through 16 inch and 12 inch main and a double line of 10 inch main under the river to the borough of Leechburg, and distributed to the inhabitants of said borough through a system of 12 inch, 8 inch, 6 inch, 4 inch, 3 inch and 2 inch pipes laid in the streets and alleys of the borough. The Leechburg Water Works Company invested in the supply lines from said connection and in the distributing system in Leechburg borough the sum of \$54,996.00 as follows:

Supply lines from reservoir connections to Leechburg borough,	\$32,046.00
System of distribution pipes in Leechburg borough,	22,950.00
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	\$54,996.00
Adding \$6,000 for "going business,"	6,000.00
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Makes the value of the borough plant in 1906 as reported,	\$60,996.00

The total amount invested in the plant in 1906 of the Leechburg Water Works Company used exclusively in supplying Leechburg borough was reported to be \$129,917.46 as follows:

Half of the cost of Beaver Run plant,	\$68,921.46
Leechburg supply lines and distribution,	54,996.00
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Total,	\$123,917.46
Going value,	6,000.00
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Total cash value,	\$129,917.46

So as reported in 1906, the total amount invested by the Apollo Water Works Company and the Leechburg Water Works Company in its plant and equipment as a whole was \$222,203.41, made up as follows:

Beaver Run plant and Owens reservoir,	\$134,842.91
Supply lines to Leechburg,	32,046.00
Leechburg distributing system,	22,950.00
Supply line to Apollo,	3,964.50
Apollo distributing system,	28,400.00
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Total,	\$222,203.41
Interest during construction,	3,000.00
Leechburg plant "going value,"	6,000.00
Apollo plant,	6,000.00
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Total,	\$237,203.41

Apollo Litigation, 1904.

The Beaver Run plant of the said Apollo Water Works Company and the said Leechburg water Works Company was completed and placed in operation in February, 1903. Since which time the company has furnished to these respective boroughs at all times an abundant and adequate supply of pure and wholesome water, and by the expenditure of the amounts above mentioned as invested in these plants have equipped themselves to fully perform and discharge all the duties and obligations resting upon them as public service corporations.

Shortly after the completion of said plant on Beaver Run and the supply lines to the borough of Apollo, the Apollo Water Works Company revised and adjusted its schedule of rates and charges in the borough of Apollo, for domestic and commercial purposes, and attempted to adjust the rates to be paid for public fire protection. Up to July, 1903, the Apollo Water Works Company had supplied water to the borough hydrants for \$500.00 per annum. On the date the company served notice on the borough, it would charge \$40.00 per annum for each fire hydrant then in service, or that might thereafter be placed in service, making an annual charge at that date of \$1,520.00. The borough, however, petitioned the court of common pleas of Armstrong County, alleging this price to be excessive and asking that the Court inquire into the facts and find and decree reasonable rates and charges for use of water for fire protection. The Court's order was as follows:

"And now, June 20th, 1904, it is ordered and decreed that on and after July 1st, 1904, that the borough of Apollo pay the Apollo Water Works Company the sum of \$22.00 per plug per annum for each of the 38 plugs used for fire purposes in the borough of Apollo, in all the sum of \$836.00 per annum, payable quarterly, and further sum of \$25.00 for each and every plug said borough shall hereafter erect and use for fire purposes."

On July 1st, 1904, in compliance with the terms of the decree aforesaid, the Apollo Water Works Company entered into a written agreement, whereby the borough was to pay the company for a period of 10 years (July 1st, 1903, to July 1st, 1913), \$22.00 per annum for 38 plugs (\$836.00 per annum), and \$25.00 per plug per annum for each and every additional plug.

The Apollo Water Works Company furnished water to the borough in compliance with the said decree and contract up to January 1st, 1914, at the rates mentioned.

Leechburg Litigation, 1906.

Shortly after the completion of the Beaver Run plant including the Owens reservoir and the supply line to the borough of Leechburg, the Leechburg Water Works Company revised and adjusted its schedule of rates and charges in the borough of Leechburg, for domestic and commercial purposes, and attempted to adjust the rates to be paid for public fire protection, but the officers of said municipality refused to enter into any agreement or contract revising or adjusting the rates to be paid for fire protection, claiming that the contract heretofore mentioned, for \$500.00 per annum entered into between the borough and the water company in 1896 had been renewed and extended. Several propositions and counter propositions were submitted, looking to a settlement of this disputed question, all of which were rejected by the borough. After August 22d, 1906, it being admitted by all parties that no contract was in existence between the water company and the borough relative to furnishing water for fire protection, the water company made a calculation of the cost of furnishing water for fire protection to the borough of Leechburg, and found that in order to meet the operating expenses incident to said service, provide a suitable sum for maintenance, and pay interest on the actual cash invested in this particular branch of the company's service, the borough of Leechburg should be required to pay at least \$3,000.00 per year for fire protection, and accordingly submitted to said borough a proposition agreeing to furnish fire protection for as many hydrants as the borough might see fit to install at the rate of \$3,000.00 per annum.

Immediately upon receipt of this proposition the borough of Leechburg by its council rejected the same, and filed a bill in equity in the Common Pleas Court of Armstrong County praying that a preliminary injunction be issued restraining the water company from shutting off the water from the various hydrants in said borough, and praying the Court to inquire into and determine as to the reasonableness of the rate proposed by the company.

In this case one of the defendant's finding of fact approved by the Court was:

"That all the money invested in the plants of the Leechburg Water Works Company and the Apollo Water Works Company including the original purchase price of the properties and all improvements and betterments was furnished by the Pennsylvania Water Company as money loaned by it to the said Leechburg Water Works Company and Apollo Water Works Company. On this loan the Leechburg Water Works Company and the Apollo Water Works Company paid in the last fiscal year of said company (April 1st, 1905, to April 1st, 1906) interest amounting to \$14,139.45. For the purpose of the present inquiry it is entirely immaterial whether the capital invested in the plants of the Leechburg Water Works Company and the Apollo Water Works Company was secured from the sale of stocks, bonds, or as a loan. It cannot matter to the customers from what source the capital invested may have come. The only question is the amount of capital actually invested, and necessarily used in supplying water to the public. The consumer has the advantage and benefit of the use of the sum invested, and indetermining how much the consumer should reasonably be required to pay for the service rendered it is only necessary to ascertain the actual amount, in good faith, invested in and the present cash value of the property

used by the public, and reasonably necessary to supply water to said municipalities."

"That the Leechburg Water Works Company is entitled to a rate of return, if its property will earn it, not less than the legal rate of interest on the value of the property at the present time actually used by the public, together with a sum sufficient to maintain the plant, pay fixed charges and operating expenses and provide a suitable sinking fund for the payment of debts."

It appears that one section of the supply line leading from Owen reservoir to Leechburg, a distance of 2,640 feet, is constructed of 16 inch pipe, while it was admitted that a 12 inch supply line would be sufficient to afford an adequate water supply to the borough of Leechburg. The extra cost of this 16 inch supply line over the cost of a 12 inch supply line amounted to \$1,610.40. This extra cost should be deducted from the total investment as found above, so it was decided, and gives the following result:

Value of the plant of Leechburg Water Works Company,	\$129,917.46
Less extra cost of 16 inch pipe,	1,610.40
Value of the present plant (1906) of the Leechburg Water Works Company, reasonably necessary and exclusively used in furnishing water to the borough of Leechburg,	\$128,307.06
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Total value of the combined present plant (1906) of the Leechburg Water Works Company and Apollo Water Works Company,	\$237,203.41
Less the cost of 16 inch pipe,	1,610.40
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Actual cash value of the combined plant of the two companies exclusively used and required to supply water to the boroughs of Leechburg and Apollo,	\$235,593.01

The books and accounts of the Leechburg Water Works Company for the 12 months ending April 1st, 1906, show the following expenditures:

Operating expenses,	\$2,191.72
Taxes,	200.00
Repairs,	808.60
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Total operating expenses,	\$3,200.32
Depreciation,	2,255.53
Interest at 6% on actual capital invested,	7,698.42
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Total,	\$13,154.27

The total receipts for the Leechburg Water Works Company for the first year ending April 1st, 1906, were:

Revenues from domestic consumption,	\$6,693.22
Private fire protection,	40.00
Estimates incidentals,	100.00
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	\$6,833.22
Fire protection,	500.00
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	\$7,333.22

Treating the works of the Leechburg Water Works Company and the Apollo Water Works Company as a single operation, the results in (1906) were as follows:

Fixed Charges.

Operating expenses,	\$6,400.65
Depreciation,	4,511.07
Interest at 6% on investment,	14,139.45
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	\$25,051.17

Total Revenue.

Leechburg domestic revenues,	\$6,693.22
Leechburg private fire protection,	40.00
Leechburg public fire protection,	500.00
Apollo domestic revenue,	6,449.54
Apollo public fire protection,	911.00
Estimated incidentals,	200.00
	<hr/>
	\$14,793.76

So it conclusively appears that the rate proposed by the Leechburg Water Works Company, to wit, \$3,000.00 in 1906 for fire protection to the borough of Leechburg would not have increased the revenues of the defendant company or companies to an amount sufficient to pay fixed charges, operating expenses, depreciation and pay a fair return or revenue to the owner of said property of at least 6 per cent on the amount invested by the companies and the present actual cash value of the property then being used by it or them in furnishing water to said borough or boroughs.

The Court affirmed the finding of fact by the defendant as follows:

"It is possible to design and construct a water works plant for fire protection alone, and it is also possible to design and construct a water works plant for the sole purpose of furnishing water for domestic and manufacturing purposes and such separate plants are now in actual use in some of the largest cities in the county, but such divided or separated services is not advisable or practicable in a town the size of Leechburg. It was, therefore, advisable and proper that when the plant of these companies was constructed at Beaver Run that it should be so constructed as to enable them to supply water for domestic and manufacturing purposes, and also furnish fire protection through the same system of pipes and reservoirs."

The Leechburg Water Works Company then figured out that of its total investment, \$128,307.06, the sum of \$30,049.49 was exclusively required to furnish water for fire protection to Leechburg borough, and should be charged as the amount invested by the defendant company in that particular branch of its service as follows:

Force main,	\$633.50
Supply line,	443.78
Duplicate pump,	5,625.00
Supply line,	16,735.49
Distributing pipes,	6,611.72
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	\$30,049.49

The Court in its discussion, said:

"It seems to us that either there is something wrong in the theory set up by the defendant corporation, as to the law of this case, or else there was a reckless and extravagant expenditure of money in the construction, maintenance and operation of their water plant."

"Its theory is that under the law it is entitled to receive a revenue per annum of \$25,051.17. That from the boroughs of Apollo and Leechburg it is necessary, a revenue of \$14,793.76. Therefore, there is a shortage of \$10,257.41. If there is no exception to the rule laid down in Brymer vs. Water Company, then this balance can be legally collected off the Borough of Leechburg. The rate for the Borough of Apollo has been legally adjusted by this Court. There is no complaint that the private consumers are not paying all they can and will pay. It will not do to say that the water company will magnanimously throw off \$7,257.41 of the amount they are entitled to, and only insist upon the payment of the balance of \$3,000.00. It is a legal question that must be determined by legal principle. To pay this amount would take more than the borough was allowed in one year to collect for gas, electricity and general borough taxes (not more than 1% on the assessed valuation for general borough purposes—\$4,454.70, and not more than 8 mills on the assessed valuation for gas, water and electric lights—\$3,563.76). And it is a larger sum than the borough could incur for a debt without the consent of the electors—(2%). There must be something wrong with a theory that worked out reaches such an unjust result."

"We think the solution of the problem can be found in the fact that the defendant corporation built its plant to supply a population of 18,000 to 20,000; and has only succeeded in getting 6,000 to consume its water. It built with the expectation of getting the borough of Vandergrift and other boroughs in the Kiskiminetas Valley to become its consumers, but they secured their supply elsewhere. A few years ago there were expectations of a great increase in the population and manufacturing in Leechburg and Apollo and vicinity, which were only realized in part. Had the future become as bright as it looked then there is no doubt that the defendant would now be realizing 6% on its investment. But this prosperity having failed to materialize the loss must fall on those whose expectations were disappointed and not upon the tax payers. The company were volunteers. They took a business risk, and like others who build ahead of the times, must wait until the population grows up to pay them a reasonable rate on their investment."

The Court's decree was dated August 26th, 1907, and it was as follows:

"*First*, that the borough of Leechburg pay to the Leechburg Water Works Company the sum of \$836.000 for the use of water from the 22d day of August, 1906, to the 22nd day of August, 1907."

"*Second*, that from the 22nd day of August, 1907, to such time as may be fixed by the further order of the Court, the borough of Leechburg pay to the Leechburg Water Works Company the sum of \$1,100.00 per annum for the use of water for as many hydrants as the borough may see fit to put in, not exceeding fifty, said hydrants to be located, set up and repaired according to the terms of the contract of October 13th, 1886. And all the other terms and conditions of said contract to remain in force except the time limit."

"Third, should the borough of Leechburg desire to put in more than fifty fire plugs, they shall pay for every fire plug so put in the sum of \$25.00, said fire plugs to be erected, and maintained according to the terms and conditions of the agreement of October 13th, 1896."

In the argument of the defendant company for appeal, the following statements were made.

"Every witness for the defense, and they were men of wide experience and recognized ability as water works engineers, testified that with the exception of the section of 16 inch pipe eliminated every part of the defendant's plant as constructed, is reasonably necessary to meet the requirements of the borough of Leechburg, while the witnesses for the borough testified substantially to the same conclusions, except alone as to the capacity of the Beaver Run impounding dam and Owens reservoir. From an analysis of the testimony, as modified by the witnesses, on cross examination, it appears that the present size and capacity of the Beaver Run dam and Owens reservoir are natural incidents arising out of the selection of unusually favorable sites and that to have constructed this dam and reservoir of less capacity would have resulted in but little saving to the defendant company and would have decreased the total investment in the joint plant of the water company less than \$10,000.00; while it is admitted that to have originally constructed these reservoirs of less capacity, would have involved the expenditure of from \$30,000.00 to \$40,000.000 to later increase their size if occasion should require. The Court's conclusion, moreover, based upon an entirely mistaken notion of the law and the principles of business experience applicable to water works construction. It is the plain duty of a water works company to exercise reasonable diligence and foresight in providing for the future, as well as present requirements in the construction of its plant. A failure to do so is a breach of the duty owed by it to the public. In this view of the matter the acquisition of property and the construction of a plant, in advance of immediate requirements, is not only justified, but such property as soon as purchased and the plant as soon as constructed, is in the true sense in use by the public, and is property included in the estimate and valuation of the company's plant and investment, devoted to the public use upon which the reasonableness of rates is to be determined. It may be true that the capacity of the Beaver Run impounding dam and the Owens reservoir is somewhat larger than absolutely required to provide an adequate water supply for the boroughs of Apollo and Leechburg at this time, but consider the unusually favorable sites selected, the minimum cost of construction incident to the sites, the slight saving in the cost of construction have resulted from decreasing their size and capacity, they are not larger than reasonable foresight, judgment, engineering skill and experience would, under the circumstances, justify."

Opinion of the Supreme Court.

The opinion of the Supreme Court was written by Mr. Justice Stewart. It was handed down January 6th, 1908, and in full was as follows:

"This is a controversy between the burgess and town council of the borough of Leechburg Water Works Company. The latter has been for years furnishing the borough of Leechburg with water for purposes of

fire protection, under contract, for the consideration of \$500.00 per annum. The contract having expired in August, 1906, the company demanded for the future an annual compensation of \$3,000.00, and threatened that unless this rate was accepted by the borough, the services to the borough for this particular service would be discontinued. The borough then offered to pay the company \$22.00 for each of the 34 hydrants then in use, and \$25.00 for each additional hydrant. This offer having been declined by the company the borough thereupon filed its bill for an injunction to restrain the company from discontinuing its supply of water, and asking the Court to fix a reasonable rate for the service. The amount of testimony taken in the case may be judged from the fact that we have before us a record of 500 pages. It is only the smallest part of the evidence that is relevant, for the reason that the effort seems to have been to apply to the determination of the issue the rule indicated in *Brymer vs. Butler Water Company*, 179 Pa. 231, which, while unquestioned as an authoritative rule, is applicable here. The Court found that a proper and reasonable charge for supplying water through as many hydrants as the borough would see fit to construct, not exceeding 50, would be \$1,100.00 per annum, and enjoined the water company from discontinuing the service. From this decree the water company has appealed. By far the greater part of the testimony taken relates to the cost of construction and value of the appellant's plant, the expense and charges incident to the operation of the same and such other matters as were supposed to furnish a basis of calculation to determine whether the rate fixed by the Court was remunerative to the company. Of the 88 assignments of error there are but few, if any, which do not relate to rulings of the Court in connection with offers of evidence in regard to such matters, or the findings of the Court with respect thereto. It is not possible to consider each of these assignments, nor is it necessary. Notwithstanding a wrong method was applied, and most of the evidence is in consequence irrelevant, there is yet sufficient in the case to enable us to reach a conclusion as to the correctness of the Court's decree. It is wholly impracticable to determine by mathematical calculation, based on cost or value of a water plant, and the expenses of operating the same, whether a single rate charge by the company for a specific service, such as a supply of water to a borough for fire protection, distinct from the other hundred or more charges for as many different services, is in itself compensatory to the company. To attempt it would be carrying what has come to be known as the segregating process in questions of this kind beyond all reasonable limit. It is to be assumed that in framing its general schedule of rates, the water company has been guided by some rule or principle which would enable it to be just to itself and at the same time enable it with reasonable approximation to make its charges for its varying services conform to some standard which would secure to the consumers reasonable uniformity in cost. In the nature of things it would be impossible to determine on the basis of the company's investment whether any specific charge for a single service, distinguishable from all others, such as a rate charged for bath tubs, or that for steam engines, or that for soda fountains, standing out of relation to the other hundred different rates charged, is in itself compensatory to the company. The company having fixed a rate for each kind of service, whether any particular rate is compensatory can only be determined by comparison with the other rates

charged, having regard to the amount of water furnished, or the facilities employed in connection with each. Assuming that the water company desires adequate compensation on the basis it has established, the only question to be determined in such case is, does the charge which the company purposes to exact for furnishing the borough with water for fire purposes, measured by the number of hydrants employed, or by the rule which the company has fixed its general schedule of rates, bear reasonable proportion to the rates established for other demands."

"There was ample in this case to warrant the conclusion reached by the Court below, according to the standard we have indicated that an annual rate of \$1,100.00 for as many hydrants not exceeding 50 as the borough chose to employ, with an additional charge of \$25.00 for each extra hydrant, was fair and reasonable alike to the company and the borough. It appears that the entire annual revenue of the company from all sources is \$6,693.22. This is derived from a population of 6,000. Manifestly a charge of \$3,000.00, a sum little less than one-half the company's income, for the supply of water for the one purpose of fire protection would be out of all proportion to the other rates established by the company. Such service may not be measured by the amount of water consumed, but even measured by the facilities employed, that is to say, the number of hydrants devoted to the purpose, considering the probable infrequency of their use, and the possibility that they would not be called into use at all, the rate demanded by the company must still be regarded as unreasonable. The assignments of error are over-ruled, the appeal is dismissed at cost of appellant, and the decree is affirmed."

The 1914 Joint Case Before the Public Service Commission.

On January 1st, 1914, the Apollo Water Works Company and the Leechburg Water Works Company pursuant to the provisions of the Public Service Company Law, published a new schedule of rates, in which the rates for fire protection was increased from \$836.00 per annum in Apollo and \$1,100.00 per annum in Leechburg to \$3,000.00 per annum in each borough, and demanded payment therefor, and still demand payment which rate the boroughs allege to the Public Service Commission is unlawful, unjust, unreasonable and extortionate.

Complaint of Apollo.

The complaint of the Borough of Apollo to the Public Service Commission is briefly this:

The population of Apollo in 1904, when the County of Armstrong fixed the fire protection rate, was 2,924, and now, in January, 1914, it is 3,006, an increase of 2.8% only. The boundary line is the same now as it was in 1904, no new streets or alleys have been laid out requiring extensions or additions to the company's mains and pipes, and that all these streets in the borough, with very few exceptions are in the same condition as they were on July 1st, 1904.

No contingencies have arisen since July 1st, 1904, to require additions to the plant of the company for the purpose of furnishing the borough water for fire protection, or which require extensions, additions and changes in its plant for the purpose of supplying private consumers with water in Apollo

borough. The conditions in every respect are the same as on the date of the Court's decree in 1904.

The number of fire plugs is now 43, and the amount of water used at fires is infinitesimal since July, 1904. The pumping station impounding reservoirs and filters built by the Pennsylvania Water Company through the said Apollo and Leechburg Companies are larger and greater in extent than is necessary to supply the present demands for water in Apollo borough. An adequate supply in quantity and quality for domestic and fire protection could have been obtained at the time of the construction of the present plant, for the borough of Apollo, at a cost not to exceed \$75,000.00, and that the site of the abandoned plant was most economical to the borough of Apollo. Said plant is now erected, is supplying water in a territory with a population of not exceeding 6,000 people, this territory being closely built up.

The entire present plant of the Apollo Water Works Company and the Leechburg Water Works Company is three times as large as is necessary to supply both boroughs, and the cost of construction was three times as great as was necessary for a plant to supply said boroughs with water.

It is alleged that a plant of sufficient size to supply pure and wholesome water to the inhabitants of the borough of Apollo and the borough of Leechburg and also to the municipalities for fire protection could be erected at the present time at a cost not to exceed \$80,000.00.

The assessed valuation of Apollo is \$617,832.00. The total tax levy possible is \$10 on \$1,000, \$6,178.32 per annum. This is required to carry on the general affairs of the borough. If the borough is compelled to pay the exorbitant rate demanded, \$3,000 per annum, it will be unable to have water for fire protection.

The Pennsylvania Water Company, through the other two water companies, has erected a plant sufficient in size to supply 25,000 people, while the present population in the district is 6,000 only. The purpose of this large plant was to supply all the citizens of the Kiskiminetas Valley, including the towns of Vandergrift, North Vandergrift, East Vandergrift, Hyde Park, Salina and other villages and boroughs or a population of 18,000.

Complaint of Leechburg.

The petition of the borough of Leechburg to intervene as a party complainant in this case before the Public Service Commission, represents substantially the same allegations as the Apollo complaint, but with certain additional allegations, etc.

The borough of Leechburg insists that the matters set forth in the complaint by the borough of Leechburg and also the petition of the Leechburg Water Works Company to have said borough of Leechburg made a party complainant have been fully adjudicated, and cannot be inquired into by the Commission; that the decree August 26, 1907, of the Court of Common Pleas of Armstrong County, proceeding Number 19, December term, 1906, remains in full force and virtue as by the provisions thereof, until further order of the Court; that the Commission is without jurisdiction to inquire into the reasonableness of the charges as fixed by the said decree of said Court, and finally affirmed by the Supreme Court of Pennsylvania.

The borough of Leechburg alleges that its population and boundaries are the same as in 1907. Also the streets as to location, extent and condition. The borough now has 44 fire plugs, which is ten more only since August, 1907.

The present erected joint works are larger and greater in extent than is necessary to supply the present demands for water for the population and other demands now taking water from the Leechburg Water Works Company. An

adequate supply in quantity and quality of water for domestic and fire purposes could have been obtained at the time of the construction of the plant of the Leechburg Water Works Company, to wit, February, 1903, for the borough of Leechburg, at a cost not to exceed \$75,000.00, and that the site of the abandoned plant of the Leechburg Water Works Company was the most economical to the borough of Leechburg. A plant for all purposes for the boroughs of Apollo and Leechburg can be built at the present time for \$80,000.00.

The assessed valuation of Leechburg is \$674,098.00. The ten mills tax per annum is \$6,740.98. If the Commission does take jurisdiction, then the Commission should place the burden upon the Leechburg Water Works Company to establish a different set of facts than those which existed at the time of the making of the decree August 26, 1907.

Answer of the Water Companies.

Among other things the following:

The two boroughs are having a normal growth. The streets are not in the same condition as in 1904 and 1907. A number of these have been graded and paved, and the water companies have been obliged to change their mains, replacing some of them with larger ones, and make necessary connections before the permanent pavement was laid.

There has been a material increase in the number of consumers since 1904 and 1907, and this has required extensions to reach them.

The Public Service Commission is requested to inquire into, determine and fix a complete schedule of rates, domestic, industrial and public for both water companies, for both boroughs and vicinity.

First Engineering Conference.

The first engineering conference was held at the Fort Pitt Hotel in the city of Pittsburgh, June 10th, 11th and 12th, inclusive, 1915, and was attended by Leo Hudson, Consulting Engineer, N. S. Sprague, Consulting Engineer and R. H. Wilson, borough Engineer, representing the complainants, the boroughs of Apollo and Leechburg; W. C. Hawley, Chief Engineer and General Superintendent and Morris Knowles representing the respondents, the Apollo Water Works Company and the Leechburg Water Works Company; and F. Herbert Snow, Chief, Bureau of Engineering, Public Service Commission. On the day previous members of the party made a field investigation of the water works system supplying the two municipalities in question.

The following is a copy of the programme for the conference as agreed to Thursday morning, June 10, 1915:

Whereas, the complainants—Apollo and Leechburg—claim that:

- A—The water company in each place has increased the fire protection service rates without warrant in law, or justice, or equity;
- B—This increased rate is excessive and that no rate can be made over the orders of the Court of Armstrong County of 1906 unless the expenditures for additions and extensions to the companies' properties since that date justify an additional revenue;
- C—The complainants say that the plant is over developed; that much money has been expended for facilities not used and useful for Apollo and for Leechburg, their needs or purposes. Hence this excessive amount of money so expended in Apollo and Leechburg

shall not be included in the sum which is the value of the properties upon which rates can be based for Apollo and for Leechburg; but these complainants allege that such fair sum is the cost of constructing an independent plant for each borough, according to plans which the engineers representing these complainants are to submit:

Proposed Procedure of Conference: That the engineers for the complainants and respondents must with the engineer of the Commission, as per agreement of counsel of both parties and the Public Service Commission, look into the expenditures, costs and values of additions and extensions to the companies' properties since the 1906 orders of the Court of Armstrong County. The engineers will then add to this cost the cost of the works prior to 1906, which will give the total cost up-to-date of the plant and properties of the companies.

Then the question in general will be whether such a total cost is the fair value of the properties to-day. If not, then we will discuss why not; and when we find in determining what is the fair and reasonable present value of the properties—not for the Commission, but as engineers representing all parties—that will be the sum which the companies claim in this case they are entitled to earn a fair return upon.

The engineers of this conference are to look into the matter covered by the above claim "C" of the complainants and attempt to reach an agreement upon it; that is, for a practical plant and the cost thereof of an independent water works for Apollo and Leechburg.

Then we will take up the matter, as alleged by the complainants, as to whether the existing plant is in fact too large and expensive for Apollo and for Leechburg; and if so, determine where and how much too large it is—in whole or in parts—and fix the value thereon.

On June 10th, at the first meeting of the conference, a program was agreed upon. Reference should be made to the complete statement of the agreements reached at this first conference, which in full is herewith appended.

On June 12th, when this first conference was concluded, the following matters had been agreed to:

- 1—Inventory of distribution system including lengths of different sizes of pipe, number of hydrants and valves, service lines, meters installed, real estate buildings and miscellaneous property.
- 2—Values were placed upon the items of real estate and buildings and miscellaneous property on prices for pipe, service connections, meters and valves.
- 3—The summary of values of the physical property in Apollo was thus determined as of April 1st, 1914, to be \$55,464.49. Non-physical values, \$5,946.16. Total, \$61,410.65. To this was added for the supply main in Washington Township leading to Apollo, \$4,610.65, making a grand summary of \$66,021.30.
- 4—The valuation of the Apollo water works in Kiskiminetas Township on the above basis was determined to be \$7,875.14.
- 5—The valuation of the water works in Washington Township was determined to be \$4,364.86.
- 6—The total valuation of the Apollo water works property and plant as of April 1st, 1914, exclusive of supply was determined to be, therefore, \$78,261.30.

Also on June 12th the following matters were agreed to respecting the Leechburg water works:

- 1—Inventory of distribution system the same as for the Apollo water works.
- 2—Values were placed upon real estate, miscellaneous property and the other various items the same as for the Apollo water works.
- 3—The summary of values of the physical property in Leechburg as of April 1st, 1914, was determined to be \$42,459.28. Non-physical value, \$6,024.91. Total, \$48,484.19. To this was added the supply main in Allegheny Township leading to Leechburg, \$32,980.53 making a grand total of \$81,464.72.
- 4—The valuation of the Leechburg water works in Gilpin Township was determined to be \$5,588.98.
- 5—The valuation of the water works in Allegheny Township, excluding the supply main was determined to be \$89.40.
- 6—The total valuation of the Leechburg water works property and plant as of April 1st, 1914, exclusive of supply was therefore determined to be \$87,143.10.

On June 12th, the conference determined that the actual cost of the source of supply, prior to July 1st, 1906, was as follows:

Impounding reservoir, Beaver Run,	\$38,606.89
Filter plant, Beaver Run,	48,988.40
Pumping plant, Beaver Run,	15,375.84
Force Mains,	17,022.68
Owens distributing reservoir,	24,007.12
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	\$144,000.93

The cost of additions and extensions to the source of supply from July 1st, 1906, to April 1st, 1914, was determined to be as follows.

Impounding reservoir, Beaver Run,	\$5,221.66
Filter plant, Beaver Run,	11,950.04
Pumping plant, Beaver Run,	7,586.99
Force main,	497.54
Owens reservoir,	77.68
Gilkerson reservoir,	31,372.21
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	\$56,706.12

Adding the cost of these units as of July 1st, 1906, and between that date and April 1st, 1914, and we obtained as the cost of the supply to April 1st, 1914, the following:

Impounding reservoir, Beaver Run,	\$43,828.55
Filter plant,	60,938.44
Pumping plant,	22,962.83
Force mains,	17,520.22
Owens reservoir,	24,084.80
Gilkerson reservoir,	31,372.21
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	\$200,707.05

The Apollo water works company owns the supply, so it was reported. Hence it was determined at the conclusion of the first conference that the Apollo water works system was worth the cost of supply and the distribution system plus some other non-physical items, as follows:

Apollo water works complete,	\$289,868.35
Entire Leechburg water works,	87,143.10

Grand total value of entire system, \$377,011.45

The foregoing figures and determinations of the supply system are based upon the money actually paid out. The figures with respect to the distribution system in the boroughs and townships are the fair reproduction cost new of the system as determined by the engineers in conference.

Second Engineering Conference.

The second engineering conference was held in Pittsburgh, June 18th and 19th, inclusive.

On June 19, when the second engineers' conference was concluded, the following matters had been agreed upon:

- 1—Quantity of water sold and the revenue therefrom.
- 2—Annual expenses of operation, general expenses, maintenance, taxes and insurance, interest and appreciation.
- 3—Total receipts and expenditures.
- 4—Gross operating revenue.
- 5—Gross operating expenses.
- 6—Net operating profit.

For the Apollo Water Works Company and the Leechburg Water Works Company, independently and as a joint plant, figured from the books and accounts of the said companies, as figured by the engineers in conference, on the basis that the said companies' accounts are correct.

Also from the book account a statement of the total investment.

Also depreciation value determined for the source of supply by items.

It was agreed that a committee should work up depreciation for the distribution system during the interim between the second and third conference.

Conclusion.

At the conclusion of the year's work, for which this report was written, it was the intention of the engineering conference in this case to proceed with the conference and to reach an early termination of the work.

EMLENTON WATER COMPANY.

Peter C. Curry et al. made complaint to the Public Service Commission against the Emlenton Water Company with respect to rates and service, and more particularly with respect to a schedule of rates recently adopted and put in force by the Company, under which charges were advanced over what they had been in the past.

The Commission heard the case which finally centered upon the appraisal of the property of the respondent made by John N. Chester of Chester & Fleiming, Consulting Engineers, employed by the company. Considerable testimony was

adduced at the hearing to the effect that this appraisal was not fair and equitable and that it represented a value much in excess of the fair value of the property for rate-making purposes. It was finally decided by the Commission to have its own engineer appraise the property and this report describes in detail the work done and the appraisal made by the Commission's engineer, and a discussion of the results.

General Conditions.

Emlenton borough is a residential community containing about 1,200 inhabitants, located on the north bank of the Allegheny River, in the extreme southeastern corner of Venango County. For nearly four decades the town has remained stationary in population. The village is located partly on the slope of a high ridge and partly on the flats along the river. This low lying section is from 20 to 50 feet above the low stage of the river.

The existing water works comprise a river intake crib, pumping station, filter plant, storage and distributing reservoir, and pipe system. Raw water from the river is pumped direct to the raw water basin or sedimentation tanks and supplied therefrom to the filters by gravity.

The pumping station is located on the river bank. The elevation of the engine room floor, which is 6 inches below the top of the pump pit, is 888.9. The extreme high water level during the past 20 years occurred on March 26th, 1913, when the elevation reached 888.0.

The town service pumping equipment consists of a 60 H. P. gas engine located on the pump house floor, belt connected to a triple pump situated in the pump pit and having a capacity of 18,000 gallons per hour. A 60 H. P. return tubular boiler and horizontal triplex steam pump are kept in readiness for emergencies. There is one suction line from the pump house. It is 8 inches in diameter and extends a distance of about 265 feet to a crib constructed of planking and covered with gravel and located in the bed of the stream near the middle of the river.

The filter plant is of the mechanical type and consists of two units, each filter having a capacity of 260,000 gallons. This plant is located in the new filter building on the river bank adjacent to the new pumping station. The foundations comprise a reinforced concrete clear water well built beneath the filters. The coagulant and dosing apparatus is placed on top of the filters and the settling tank adjacent to the filters. This tank has a capacity of 37,800 gallons. The filter plant has a capacity of 432,000 gallons per 24 hours when the filters are operated at the rate of 125,000,000 gallons per acre per day. This gives approximately 2 hours' settling in the sedimentation tank. The daily consumption in the town is about 180,000 gallons per 24 hours and the plant is operated for a period of about 10 hours each day. When it becomes necessary to repair or clean one of the filters, the other filter will be operated for a period of 20 hours.

There are two centrifugal or raw water pumps in the pit which are used to supply the raw water to the settling tank. The capacity of each is 18,000 gallons per 24 hours. The filters are washed by the reversal of the filtered water current. Rate controllers and loss of head gages are supplied for each unit. Alum is used as a coagulant and hypochlorite of lime as a germicide.

This filter plant and the entire water works system was approved by the Commissioner of Health of the Commonwealth in a permit issued March 11, 1914, which provides, among other things, that bacteriological analyses of

the raw and filtered water shall be made monthly, or more often if required, that weekly reports of the operation of the plant and system shall be kept on forms satisfactory to the Commissioner of Health, and copies thereof shall be filed in the office of said Commissioner, and that if at any time in his opinion the water works system, or any part thereof, or the water supplied thereby is prejudicial to the public health, then such remedial measures shall be adopted by the water company as the said Commissioner may advise or approve.

The water from the filter plant is pumped directly to the storage reservoir located on the hill back of the town. It is 70 feet in diameter, 8 feet deep and has a capacity of 230,000 gallons. It is elevated 380 feet above the pumping station. The old reservoir adjacent to the new one, due to leaks and need of repairs, has been temporarily abandoned. The pipe distributing system of the town contains some dead ends. These are to be eliminated to quite an extent during the current season. The filter plant has been in operation a few weeks only. Prior to this time raw river water treated with a germicide has been applied after sedimentation in the reservoir on the hill. Probably deposits in the mains exist to a considerable extent.

The water company was compelled to erect the filter plant and to provide the raw water pumping machinery. This made necessary the purchase of additional land on the river front and adjacent to the pumping station and the erection of the filter building. Altogether the outlay approximated about \$11,000.

In 1908, an effort was made by the water company to obviate the construction of a filter plant by the securing of pure water from the ground. At that time the pump house consisted of the old brick structure, enclosing the pit of water tight masonry construction, 18 feet in diameter and 28 feet deep. This is a pit in which is located the pumping machinery. The water was raised vertically through an 8 inch and 6 inch line 2,690 feet long to the distributing reservoir on the hill. But the water could be pumped directly into the street mains by the manipulation of valves at the pump house. The system of distributing mains in the streets then totaled 4.7 miles. Over one mile in length was 6 inch pipe. Nearly two miles was 4 inch pipe and about one mile was 3 inch pipe. At convenient points in the village fire hydrants were installed. Along the river front there were several blow-offs which admitted of ready drainage of the water pipe system. The water company endeavored to entirely abandon the river supply. It drilled 6 wells at the reservoir on the hill. These wells had a depth ranging from 229 to 311 feet. The water bearing stratum into which the wells were drilled is white sand porous rock, having its general slope towards the Allegheny River. The various springs in the borough along the side of the ridge slope were thought to be outlets of this same stratum. The water company preferred to secure a pure supply from this source rather than to filter an impure water, and the proposed plans for the drilled wells were approved by the Commissioner of Health, subject to certain stipulations. However, the well supply proved inadequate and the money expended therefor was of no avail.

The water works system was constructed in 1877. It appears that the original source of supply was various springs located in the hills on both sides of the river, but above the dwellings. Finally, owing to the inadequacy of this spring supply, it was abandoned and substituted by the river supply. All of which is relevant to the inventory and appraisal hereinafter offered.

Inventory and Appraisal.

Taking the inventory of Chester & Fleming, engineers employed by the Emlenton Water Company, I checked up the items in a general way and fixed

values therefor, placing them opposite the values made by said engineers, as follows:

A—Real Estate.

	C. & F.	SNOW.
Pumping Station lot, filter plant lot and old Bond property,	\$2,300.00	\$2,300.00
Two city lots,	1,000.00	800.00
Reservoir lot about 1½ acres,	500.00	500.00
Right of way for main pumping line,	150.00	150.00
	<u>\$3,950.00</u>	<u>\$3,750.00</u>

NOTE.—The Company paid \$500.00 for the old pumping station site, \$1,800.00 for the reservoir plant and old Bond property site. The Company paid \$500.00 for the reservoir lot. This was part of a man's farm, and while the lot was probably not worth \$300.00 the company had to pay the purchase price \$500.00.

B—Transmission and Distribution.

Cast Iron Pipe.

Lineal feet laid excluding trenching:

	C. & F.	SNOW.
4,978'—3" pipe at 26c.,	\$1,294.28	\$1,294.28
10,364'—4" pipe at 35c.,	3,627.40	3,627.40
8,307'—6" pipe at 50c.,	4,153.50	4,153.50
1,715'—8" pipe at 70c.,	1,200.00	1,200.00
Total,	<u>\$10,275.68</u>	<u>\$10,275.68</u>

Wrought Iron Pipe.

1,201'—1" pipe at 9c.,	\$108.09	\$108.09
634'—2" pipe at 18c.,	114.12	114.12
649'—3" pipe at 27c.,	175.23	175.23
Total,	<u>\$397.44</u>	<u>\$397.44</u>

Gate Valves.

1—2" at \$3.50,	\$3.50	\$3.50
20—3" at \$6.60,	132.00	132.00
21—4" at \$8.80,	184.80	184.80
19—6" at \$14.00,	266.00	266.00
3—8" at \$20.00,	60.00	60.00
Total,	<u>\$646.30</u>	<u>\$646.30</u>

Cast Iron Specials.

The weight of specials is calculated as being equal to 2.5% of weight of pipe in street mains.

	C. & F.	SNOW.
8.3 tons of cast iron hub and spigot specials at \$55.00,	\$456.00	\$456.00
Special in wrought iron mains:		
1,201'—1" main, } Average cost of specials is		
634'—2" main, } 6% of cost pipe laid or		
649'—3" main, } 6% of \$397.00,	24.00	24.00
Total,	\$480.00	\$480.00

*Trenching.**Easy Digging:*

1,705'—8" pipe at 19c.,	\$325.85	\$325.85
3,021'—6" pipe at 16c.,	483.36	483.36
7,015'—4" pipe at 15c.,	1,052.25	1,052.25
2,368'—3" pipe at 15c.,	355.20	355.20
524'—2" pipe at 14c.,	73.36	73.36
1,201'—1" pipe at 14c.,	168.14	168.14
All rock requiring some blasting:		
598'—3" pipe at 74c.,	442.52	442.52

Bed Rock:

1,080'—6" pipe at 50c.,	\$540.00	\$540.00
1,145'—3" and 2" pipe at 45c.,	515.25	515.25

All Picking:

4,206'—6" at 21c.,	883.26	883.26
3,349'—4" at 20c.,	669.80	669.80
1,626'—3" at 20c.,	325.20	325.20
Total,	\$5,834.19	\$5,834.19

Fire Hydrants.

25—Ludlow Hydrants—1—2½" stream and nozzles at \$35.00,	\$875.00	\$875.00
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Service Lines and Service Connections.

These are owned by the Company and have an average length of 12 feet and size is $\frac{3}{4}$ inch.

206 galvanized iron services, corporation cock, curb cock, service box, light goose neck at \$8.50,	1,751.00	1,751.00
80 galvanized services as above including cost of permit from city for laying of pavements at \$10.50,	840.00	840.00
	\$2,591.00	\$2,591.00

Meters in Service.

	C. & F.	SNOW.
14—Empire & Nash $\frac{3}{8}$ " meters at \$12.40,	\$173.60	\$173.60
1—Keystone $\frac{1}{4}$ " meter at \$18.00,	18.00	18.00
1—Keystone 1" meter at \$24.50,	24.50	24.50
Total,	<u>\$216.10</u>	<u>\$216.10</u>

Gate Boxes and Man Holes.

These are owned by the Company.

24—gate valve boxes at \$4.50,	\$108.00	\$108.00
35—Man holes— $\left\{ \begin{array}{l} 8'' \text{ brick holes,} \\ 4'' \text{ diameter of bottom, ..} \\ 2' \text{ diameter at top,} \\ 5\frac{1}{2}' \text{ deep,} \\ 4,900 \text{ brick at } \$16.00 \text{ per} \\ \text{thousand,} \end{array} \right\}$	784.00	784.00
35—covers at \$7.00 each,	245.00	.....
202 cu. yds. excavation for above at 60c.,	121.20	121.20
Total,	<u>\$1,258.20</u>	<u>\$1,258.20</u>

Railroad Crossings.

Eighth Street & First Street—2 tracks crossed at \$16.00,	\$32.00	\$32.00
Tenth Street, 1 track crossed at \$24.00,	24.00	24.00
Total,	<u>\$56.00</u>	<u>\$56.00</u>

*Intakes, Suction Lines and Pit.**Suction Lines:*

175'—8" W. I. pipe (dredging cost included with crib) at \$3.00,	\$525.00	\$525.00
95'—8" C. I. pipe (dredging cost included with crib) at \$2.50,	237.50	237.50
156'—8" C. I. pipe (dredging included with old lines) at \$2.50,	390.00	390.00
Total,	<u>\$1,152.50</u>	<u>\$1,152.50</u>

Regulator and Pit:

Regulator,	\$375.00	\$375.00
Regulator Pit,	96.00	96.00
Total,	<u>\$471.00</u>	<u>\$471.00</u>

C—Buildings and Miscellaneous Structures.

Brick Pumping Station Building 60 feet long,
40 feet 3 inches wide and 17 feet high.

	C. & F.	SNOW.
Earth Excavation, 45.5 cu. yds. at 60c,	\$27.30	\$27.30
Back Filling, 575.1 cu. yds. floor at 50c,	287.55	287.55
Masonry and foundations, 2,616.17 cu. yds.= 57568 brick at \$14.00,	805.98	805.98
Masonry and walls above, 2856.8 cu. yds.= 62850 bricks at \$16.00,	1,005.60	1,005.60
Concrete Floor, 12.8 cu. yds. at \$10.00,	128.00	128.00
Timber & Roof, 64.80 F. B. M. at \$40.00,	259.20	259.20
Roof covering, 26.2 sqs. at \$10.00,	262.00	262.00
Windows, 7—3½' x 7½' at \$9.00,	63.00	63.00
Doors, 1—double at \$10.00,	10.00	10.00
Painting, 5560 sq. ft. at \$.025,	139.00	139.00
Ceilings, 1386 F. B. M. at \$60.00,	83.16	83.16
Timber crib & south wall, 6500 F. B. M. at \$35.00,	227.50	227.50
Chimney, 4766 brick at \$16.00,	76.26	76.26
Pipe supports, 50'—5½" W. I. pipe, at 44c, ..	22.00	22.00
Sky Lights, 72 sq. ft. at 80c,	57.60	57.60
Tie Rods, 2—¾", 62' long,	10.00	10.00
Sink and water line,	7.90	7.90
Total,	<u>\$3,472.05</u>	<u>\$3,472.05</u>

Filter Building.

Earth excavations, 9 cu. yds. at 60c,	\$5.40	\$5.40
Back filling, 586 cu. yds. at 25c,	146.50	146.50
Masonry and foundations, 163 cu. yds. con- crete, at \$7.00,	1,141.00	1,141.00
Masonry and wall above, 68.7 cu. yds. Tile at \$5.50,	378.00	378.00
Wood Floors, 394 F. B. M. at \$40.00,	15.76	15.76
Timber & Roof, 7472 F. B. M. at \$50.00,	373.60	373.60
Roof covering, 28.2 sqs. tar paper at \$2.50, ..	70.50	70.50
Windows, six 3 x 8' at \$9.00,	54.00	54.00
Doors, one double 7 x 8',	11.00	11.00
Total,	<u>\$2,195.76</u>	<u>\$2,195.76</u>

New Shed.

Earth Excavation, 15.5 cu. yds. at 60c,	\$9.30	\$9.30
Masonry and foundations, 13.6 cu. yds. con- crete, at \$7.00,	95.20	95.20
Masonry and walls, 33.1 cu. yds. Tile at \$5.50, ..	182.05	182.05
Concrete floors, 10.6 cu. yds. at \$10.00,	106.00	106.00
Timber & Roof, 4231 F. B. M. at \$40.00,	169.24	169.24
Main Wall Grating,	2.25	2.25
Sewer, 109'—4" at 35c,	38.15	38.15
Wall Line,	4.78	4.78
Total,	<u>\$606.97</u>	<u>\$606.97</u>

Old Barn.

	C. & F.	SNOW.
Masonry and wall above Tile, 42.5 cu. yds. at \$5.50,	\$233.75	\$233.75
Timber & Roof, 16000 F. B. M. at 40c,	640.00	640.00
Roof covering, 36 sqs. tar paper, at \$2.50, ..	90.00	90.00
Timber and walls, 1750 F. B. M. at 40c,	70.00	70.00
Total,	<u>\$1,033.75</u>	<u>\$1,033.75</u>

Store House.

16' long, 12' wide, 12' high, price,	\$50.63	\$50.63
New Reservoir 70' in diameter:		
Excavation 745 cu. yds. at 50c,	862.50	817.50
Masonry in bottom lining, 309 cu. yds. concrete at \$7.00,	21.63	21.63
Masonry inside 3093 cu. ft.= 6800 brick at \$14.00,	952.00	952.00
Pipe Posts, 314'—1" at 4c,	12.56	12.56
Fence Wire 1355 sq. ft.,	10.17	10.17
Total,	<u>\$4,023.00</u>	<u>\$3,655.23</u>

Old Reservoir.

Excavation 2112 cu. yds. at 50c,	\$1,056.00	\$633.60
Puddle, 614.5 cu. yds. at \$1.00,	1,614.50	1,614.50
Masonry and bottom lining, 135.6 cu. yds. concrete at \$7.00,	949.20	949.20
Masonry inside 92.1 cu. yds. stone at \$5.50, ..	506.50	506.50
Iron Posts, 177' at 3c,	5.31	5.31
Total,	<u>\$3,131.51</u>	<u>\$2,709.11</u>

Old Crib.

Dredging, labor, building and placing crib,	\$2,300.00	\$1,300.00
Timber in crib, 17436 F. B. M. at \$35.00,	610.00	610.00
Total,	<u>\$2,910.00</u>	<u>\$1,910.00</u>

Filter and Filter Plant Equipment.

Masonry and filter tops, 234 cu. yds. re-inforced concrete at \$14.00,	\$3,276.00	\$3,276.00
Lumber & platforms, 592 F. B. M. at \$40.00, .	23.68	23.68
Excavation 264 cu. yds. at 50c,	132.00	132.00
Filter Equipment:		
Cragulane solution, tank wire box, strainer system, filter material, wash troughs, water and iron piping, pipes, boiler, valves and valve stands, rate controllers, hypo. tank & outfit,	3,360.00	3,360.00
Total,	<u>\$6,891.68</u>	<u>\$6,891.68</u>

Miscellaneous Timber.

	C. & F.	SNOW.
737 F. B. M. at \$30.00,	\$22.10	\$22.10

D—Pumping Station Equipment.

1 Smith-Vaile-Stillwell-Bierce steam pump 16 inch H. P. cylinder, 7 inch plungers 12 inch stroke (Installed 1902),	\$750.00	\$750.00
Excavation foundation 20.4 cubic yards at 50c,	10.20	10.20
Masonry and foundation 12.7 cu. yds. at \$7.00,	88.90	88.90
Freight, hauling and setting,	150.00	150.00
	\$999.10	\$999.10
1 power driven pump (Installed 1902),	1,400.00	1,400.00
1 Foos gas engine (170 R. P. M. speed-68 speed)		
1 Smith-Vaile-Stillwell-Bierce-triplex (9 inch plungers 12 inch stroke),	1,800.00	1,800.00
Freight, hauling and setting pump,	300.00	300.00
Excavation for pump pit 552 cu. yds. at \$1.50,	828.00	828.00
Concrete bottom 59.1 cu. yds. at \$8.00,	472.80	472.80
Brick Sides 53,000 bricks at \$16,	848.00	848.00
Timber coffer dam 7640 F. B. M. at \$35,	267.40	267.40
Structural supports 4635 lbs. at 5 cts.,	231.75	231.75
8 Oil cups at \$2,	16.00	16.00
Railing and wood floor,	11.85	11.85
Freight, hauling and setting engine,	150.00	150.00
Excavation 45 cu. yds. at 50 cents,	22.50	22.50
Foundation 23.5 cu. yds. at \$7,	164.50	164.50
12 inch 6 ply belt,	90.00	90.00
	\$6,602.80	\$6,602.80
1 Foos gas engine including shafting, pul- leys, etc. belt drive 15 H. P.,	650.00	650.00
2 Platt centrifugal No. 4 including freight (Rated capacity 300 gals. per minute),	497.00	497.00
Freight, hauling and setting engine,	75.00	75.00
Excavation 14.4 cu. yds. at 50 cents,	7.20	7.20
Foundation 6 cu. yds. at \$7.00,	42.00	42.00
Belts,	35.00	35.00
Line shaft excavation 15 cu. yds. at 50 cents,	7.50	7.50
Line shaft foundation 11.6 cu. yds. at \$7,	81.20	81.20
Hauling and setting pumps and foundation (Installed 1914),	35.00	35.00
	\$1,429.90	\$1,429.90
1 Steam boiler, Erie fire tube 56 in. dia. 16 ft. long 3 in. tubes 72 H. P., (Installed 1892),	650.00	650.00
Setting,	400.00	400.00
Excavation 10 cu. yds. at 50 cents,	5.00	5.00
Foundation 8 stone at \$5.50,	44.00	44.00
	\$1,099.00	\$1,099.00

Discharge Piping Inside of Buildings:

Power Pumps,	\$263.50	\$263.50
Steam Pumps,	108.04	108.04
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	\$371.54	\$371.54
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Pump Suction Piping Inside of Buildings.

In pump station,	\$154.22	\$154.22
Clear well to large pump,	44.89	44.89
To steam pump,	27.28	27.28
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	\$226.39	\$226.39
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Miscellaneous Equipment.

Water feed line,	\$7.33	\$7.33
Blow-off line,	3.76	3.76
Water line,	40.89	40.89
Air line 2.5 inches and 3 inches,	16.24	16.24
Relief valve,	16.89	16.89
Hypo line,	9.97	9.97
Water line to hypo,	2.85	2.85
Railing,	2.40	2.40
Air line,	8.65	8.65
Sewer outlet,	10.36	10.36
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	\$119.32	\$119.32
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Steam Piping Large Sizes.

$\frac{3}{4}$ " and 2.5",	\$19.30	\$19.30
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Exhaust Piping.

3" exhaust line,	\$6.56	\$6.56
Gas engine exhaust,	49.34	49.34
Steam pump exhaust,	5.35	5.35
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	\$61.25	\$61.25
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*General Equipment.**Utility Equipment—Illuminating.*

1", 2" and 3" fuel gas line,	\$106.35	\$106.35
$\frac{3}{8}$ " and $\frac{1}{2}$ " illum. gas lines,	27.30	27.30
Gas line to hypo,	5.48	5.48
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	\$139.13	\$139.13
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Miscellaneous.

Pelton wheel installed 1902,	\$100.00	\$100.00
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Tools and Instruments.

1 ladder 22 x 4" x 12' long,	\$2.00	\$2.00
1 lead laddle,40	.40
1 wood block,71	.71
1 pair 4" tongs,	3.31	3.31
1 pair 6" tongs,	5.50	5.50
2 crow bars,	3.00	3.00
1 pair boots,	3.00	3.00
6 steel barrels,	18.00	18.00
Bolts, nails, etc.,	1.00	1.00
Melting furnace,	33.60	33.60
1 pair chain tongs,	6.40	6.40
4 working barrels 3" by 5" long,	40.00	40.00
Polish rods 6 at 10 feet long,	6.00	6.00
150 feet of cable $\frac{1}{4}$ " at 4 cts,	6.00	6.00
1 copppe oil can, .....	.75	.75
1 sprinkling can, .....	.50	.50
1 shovel,	1.00	1.00
1 mueller tapping machine,	78.00	78.00
5 snakes 3" to 8" pipe,	7.50	7.50
Old tapping machine,	15.00	15.00
1 old man,	4.00	4.00
1 bit,	2.00	2.00
5 lanterns,	1.14	1.14
2 level boards,	5.00	5.00
15 feet $\frac{1}{2}$ " rubber hose,	1.50	1.50
1 gas stove,	1.50	1.50
45 feet $\frac{1}{2}$ " garden hose,	4.05	4.05
1 gas stove,	3.50	3.50
20 wrenches,	5.00	5.00
4 oil cans,	1.40	1.40
1 trowel,	1.00	1.00
1 diaphragm pump,	16.00	16.00
1 scythe,	2.00	2.00
	<u>\$279.76</u>	<u>\$279.76</u>

F—Paving.

2425 linear feet of pipe under pavement (brick on sand and concrete cement filler) at 75 cents,	\$1,818.75	\$1,818.75
1260 feet paving over services at 75c.,	945.00	945.00

G—Materials and Supplies.

100 lbs. scrap brass at 11 cts.,	11.00	11.00
6 sets valves and 3" working parts, 1 gate and screw connection for cleaning reservoir, Fittings,	10.00	10.00
10 Pump roads 20' long, poor shape, at \$4.00, 600 lbs. scrap iron,	40.00	40.00
2.5 bbls. salt,	3.00	3.00
2.5 bbls. salt,	4.50	4.50
20 lbs. babbitt metal,	2.00	2.00
4 windows at \$2.00,	8.00	8.00

Valves,	6.00	6.00
Packing,	10.00	10.00
1 exhaust casing,	30.00	30.00
100 lbs. Hypo,	2.90	2.90
Scale,	1.00	1.00
Hemp, .....	.50	.50
3—4" gate valves at \$8.80,	26.40	26.40
Fittings,	10.00	10.00
45 bbls. cement at \$1.65,	74.25	74.25
1 fly wheel 2600 lbs. at \$.035,	91.00	91.00
7 keys at \$2.50,	17.60	17.60
1 bale waste,	15.00	15.00
1 bearing,	20.00	20.00
5000 lbs. C. I. Specials at \$.0275,	137.50	137.50
1 hose nozzle,	1.00	1.00
1— $\frac{1}{2}$ " nipple, .....	.01	.01
1 Globe or throttle $\frac{1}{2}$ " valve, .....	.40	.40
Pipe fitting,	10.00	10.00
1 engine piston and pin,	82.00	82.00
4 piston pins on pump at \$4.00,	16.00	16.00
2 New Ludlow Hydrants at \$20.00,	40.00	40.00
20'—4" pipe at 24c,	4.80	4.80
1 air tank,	7.00	7.00
20 services boxes at 95c,	19.00	19.00
12 Service stubs at 70c,	8.40	8.40
8 gal. paint at \$1,	8.00	8.00
$\frac{1}{2}$ ton coal at \$2.25,	1.12	1.12
12 ft. 6" rubber pipe,	10.68	10.68
2 sets window panes, 5 x 5,	20.00	20.00
250 lbs. lead,	7.50	7.50
Gas engine parts at \$5.00,	5.00	5.00
1 barrel alum at \$22 per ton,	4.00	4.00
1 magneto,	20.00	20.00
1—6" screw T,	1.20	1.20
3—6" plugs at \$.36,	1.08	1.08
3—6" bushings at \$.375,	1.12	1.12
1—6" nipple, .....	.32	.32
3—water ends weighing 4000 lbs,	60.00	60.00
1—Engine cylinder weighing 2000 lbs.,	50.00	50.00
7— $\frac{5}{8}$ Empire meters at \$10.40,	72.80	72.80
1— $\frac{5}{8}$ " Nash meter,	8.40	8.40
2— $\frac{3}{4}$ " Empire meters at \$15.60,	31.20	31.20
Oil 2-3 bbl. at \$10.40,	6.95	6.95
6000 brick, second hand at \$5.00,	30.00	30.00
400 cu. ft. new tile, per cu. yd. at \$3.00,	44.00	44.00
1 old water tub 6' x 8',	2.00	2.00
4.5 bbl. crude oil at \$2.50,	11.25	11.25
2 tons gravel at \$.80,	1.60	1.60
Lumber from concrete forms,	150.00	150.00
1 Poppet valve,	3.00	3.00
Engine material,	3.00	3.00
50 pump valves at \$.25,	12.50	12.50
Battery material,	5.50	5.50
Scrap lead,	2.00	2.00

1 length 8" screw pipe, 19 ft. at \$1.00,	19.00	19.00
94 length 6" C. I. pipe, second hand but in good shape at \$.423,	39.76	39.76
23 length 4" C. I. pipe, new at \$.297,	6.83	6.83
7 length 3" C. I. pipe at \$.222,	1.55	1.55
21 length 6" C. I. pipe, new at \$.423,	8.88	8.88
10.5 length 8" C. I. pipe at \$.602,	6.32	6.32
8 pcs. 3" about 3 ft. long at \$.222,	5.33	5.83
2 crosses, 6 x 6 x 3 x 3, 149 lbs. each at \$.0275,	8.20	8.20
1 T 6 x 6 x 3, 127 lbs. at \$.0275,	3.49	3.49
1—6" 45 deg. L. 84 lbs. at \$.0275,	2.31	2.31
3—8" 45 deg. L. 121 lbs. at \$.0275,	9.99	9.99
1—8" gate (broken),	1.00	1.00
1—old heater 8", 10 ft. long at \$8 per ton, ..	1.90	1.90
24 sets 6" river clamps with bolts 3' long, $\frac{3}{4}$ " mtl. at \$4.55,	109.20	109.20
8 pcs. heavy 6" W. I. screw pipe 20' long each at \$.40,	64.00	64.00
12 pcs. old 6" W. I. screw pipe 20' long, scrap, 6 old C. I. T's 6 x 6 x 3, 127 lbs. at \$8, per ton,	1.50	1.50
4—6" sleeves, 72 lbs. at \$.0275, .....	.50	.50
20 ft. 6" pcs. at \$.423,	1.98	1.98
1—3" T, 67 lbs. at \$.0275,	8.43	8.43
3'—3" pipe, per foot at \$.222,	1.98	1.98
50'—4" pcs., per foot at \$.297, .....	.67	.67
6 tons scrap iron, per ton \$9,	14.85	14.85
14'—6" C. I. pipe at \$.423,	54.00	54.00
3 flogging slabs 108 ft. at \$.05,	5.92	5.92
100 ft. flag walk 6' wide and filling, per ft. at \$.75,	5.40	5.40
	75.00	75.00
	<u>\$1,801.37</u>	<u>\$1,801.37</u>

SUMMARY.

Depreciation by sinking fund method, contributions at end of year, interest compounded annually at 4%.

	Reproduction cost.	Date of construction.	Estimated life in years.	Annual Depreciation.		Age in years.	Total Depreciation.		Present value.
				Per cent.	Amount.		Factor.	Amount.	
A—LANDS.									
A-1 Real estate,	3,800	.....	.....	.....	.....	.....	.....	.....	3,800
A-3 Rights of way,	150	.....	.....	.....	.....	.....	.....	.....	150
Total—A,	3,950	.....	.....	.....	.....	.....	.....	.....	3,950
B—TRANSMISSION AND DISTRIBUTION.									
B-1-a-C. I. mains,	10,276	.....	100	.08	8	22.6	35.6	285	9,991
B-1-b-W. I. mains,	397	.....	30	1.78	7	11.1	13.6	95	302
B-1-c-Gate valves,	646	.....	56	.5	3	22.2	24.7	104	542
B-1-d-C. I. specials,	456	.....	100	.08	0.36	22.6	35.6	13	443
B-1-e-W. I. specials,	24	.....	30	1.78	0.43	11.1	13.6	6	13
B-1-g-Trenching,	5,834	.....	93	.11	6	22.2	34.7	208	5,626
B-2-Fire hydrants,	875	.....	41	1.0	9	22.6	35.6	320	555
B-3 Services,	2,591	.....	30	1.78	46	22.2	34.7	1,596	995
B-4 Meters,	216	.....	25	2.4	5	1	5	3	213
B-5 Gate boxes,	1,258	.....	56	.5	6	22.2	34.7	208	1,050
B-7 Railroad crossings,	56	.....	100	.08	.....	.....	31.7	.....	56
B-8 Suction line,	1,153	1,909	41	1.0	12	5	5.4	65	1,083
Regulator and pit,	471	1,891	72	.25	1	23	36.6	37	434
Total-B,	24,257	.....	.....	.....	.....	.....	.....	2,940	21,313
C—BUILDINGS AND MISCELLANEOUS STRUCTURES.									
C-1-Buildings:									
Pump station,	3,472	1902	45	.83	29	12	15	435	3,037
Filter building,	2,196	1914	45	.....	.....	.....	.....	.....	2,196
New shed,	607	1913	45	.83	5	1	1.0	5	602
Old barn,	1,034	1909	20	3.36	35	5	5.4	189	845
Store house,	50	.....	20	3.36	2	15	20	40	10
C-2-Reservoirs:									
New reservoir,	4,090	1908	100	.08	3	6	6.6	20	3,980
Old reservoir,	3,132	1877	.....	.....	.....	.....	90%	2,819	313
C-5 Old crib,	2,910	1909	72	.25	7	5	5.4	38	2,872
C-8 Filters,	6,892	1914	72	.25	9	.....	.....	.....	6,892
C-9-c-Miscellaneous,	22	.....	.....	.....	.....	.....	.....	.....	22
Total-C,	24,315	.....	.....	.....	.....	.....	.....	3,546	20,769
D—PUMPING STATION AND EQUIPMENT.									
D-1-a-Steam pump,	999	1902	30	1.78	18	12	15	270	729
D-1-b-Trip pump,	6,608	1902	28	2.0	132	12	15	1,980	4,623
Centrifugal pumps,	1,430	1914	25	2.4	.....	.....	.....	.....	1,430
D-4 Boiler,	1,099	1892	30	1.78	20	22	34.2	684	415
D-12 Discharge piping,	372	.....	30	1.78	7	5	5.4	38	334
D-13 Suction piping,	226	.....	30	1.78	4	5	5.4	22	204
D-14 Miscellaneous piping,	119	.....	30	1.78	2	5	5.4	11	108
D-15 Steam piping,	19	.....	30	1.78	0.34	.....	5.4	2	17
D-16 Exhaust piping,	61	.....	30	1.78	1	5	5.4	5	56
Total-D,	10,928	.....	.....	.....	.....	.....	.....	3,012	7,916
E—GENERAL EQUIPMENT.									
E-1-a-Gas lines,	139	.....	30	1.78	2	5	5.4	11	123
E-1-c-Pelton wheel,	100	1902	25	2.4	2	12	15	30	70
E-1-f-Tools,	280	.....	.....	.....	.....	.....	50%	140	140
Total—E,	519	.....	.....	.....	.....	.....	.....	181	338
F—PAVING.									
F-1-Over mains,	1,819	.....	100	.08	1	22.2	34.7	35	1,784
F-2-Over services,	945	.....	30	1.78	17	22.2	34.7	590	355
Total—F,	2,764	.....	.....	.....	.....	.....	.....	625	2,139
G—MATERIALS AND SUPPLIES.									
G-1-c-Miscellaneous supplies,	1,801	.....	.....	.....	.....	.....	25%	450	1,351
	1,801	.....	.....	.....	.....	.....	.....	450	1,351

CHESTER AND FLEMING'S GRAND SUMMARY.

Item.	Reproduction cost.	Total Depreciation.		Present value.
		Factor.	Amount.	
B—Transportation and distribution,	24,253	.....	2,940	21,313
C—Building and miscellaneous structures,	24,315	.....	3,546	20,769
D—Pumping station equipment,	10,928	.....	3,012	7,916
E—General equipment,	239	.....	41	198
F—Paving,	2,764	.....	525	2,139
Engineering contract, 10 per cent.,	62,499	.....	10,164	52,335
General administration, 2 per cent.,	6,250	16.2%	1,012	5,239
	1,250	16.2%	293	1,047
Original cost, 2 per cent. on \$62,499,	69,999	.....	11,379	58,620
A—Real estate,	1,250	.....	.....	1,250
	3,950	.....	.....	3,950
Interest during construction, 2 per cent. on 75,199,	2,256	16.2%	265	1,991
	75,199	.....	.....	63,820
E—General equipment,	280	.....	140	140
G—Supplies,	1,801	.....	450	1,351
Going value,	8,054	.....	.....	8,054
Operating capital,	1,003	.....	.....	1,000
	\$88,590	.....	\$12,334	\$76,256

F. HERBERT SNOW'S GRAND SUMMARY.

B—	24,253	.....	.....	21,313
C—	22,548	.....	.....	19,332
D—	10,928	.....	.....	7,916
E—	239	.....	.....	198
F—	2,764	.....	.....	2,139
Engineering contingencies, 5 per cent.,	60,732	.....	.....	50,948
General administration, 1 per cent.,	3,037	.....	\$506	2,531
	607	.....	101	506
A—	64,376	.....	.....	53,985
Original cost, 1 per cent. on \$60,732,	3,750	.....	.....	3,750
	607	.....	.....	607
Interest during construction, 3 per cent. on \$68,733,	68,733	.....	.....	58,342
E—	2,062	.....	345	1,719
G—	289	.....	140	140
Operating capital,	1,801	.....	450	1,351
	501	.....	.....	500
	\$73,371	.....	\$11,524	\$62,052
Nothing allowed for going value.				

Discussion.

In arriving at the present value of the physical plant in the sum of \$62,052, which is the reproductive cost new less depreciation, I have been influenced that if the conservative business men engaged in handling the company's affairs were to rebuild the plant in one season, they would be influenced by the same even tenor of their way, saving where possible, spending carefully, denying themselves "plums," cutting no "melons," building substantially and well, where under other and customary guidance, such as obtains in most water works, more money would be spent for engineering, for administration and for organization expenses. I have not added going value because the finding is to be used for rate making purposes only, not for purchase or sale.

The revenues for 1913 total \$6,465.36 and for 1914, they total \$6,384.46. The expenditures each year deducted from these revenues gave net revenues as follows: \$4,064.90 and \$3,762.26 respectively. The details of these revenues are given in the following table:

	Year 1913.	Year 1914.
Water Sales:		
Commercial,	\$850 53	\$617 12
Industrial,	115 00	163 41
Domestic,	5,187 33	5,291 42
Fire protection,	312 50	312 50
Total sales,	\$6,465 36	\$6,384 46
Expenditures:		
Rents,	48 00	56 00
Taxes,	173 26	258 44
Salaries and wages,	1,125 00	1,120 00
Office supplies,	1,375 00	50 00
Labor,	127 79	211 55
Repairs,	299 75	68 53
Plant supplies,	80 08	290 53
Oil and tallow,	58 08	42 40
Gas,	474 75	524 75
	\$2,400 46	\$2,622 20
Net income,	\$4,064 90	\$3,762 26

The filter plant was built last year and has been in operation a few weeks. It requires that a man shall be on hand to operate it 8 hours per day. The filter plant expenditure was required by the State and the extra cost to operate has been placed upon the company. In the following table the estimated expenditures for operating the plant and the water works system for the year 1915 are given:

ESTIMATED EXPENSES FOR 1915.

Operation.

Rents,	\$60.00
Taxes,	350.00
Salaries and wages:	
Superintendent,	\$960.00
Assistant,	600.00
Analyses,	72.00
	1,632.00
Office supplies,	50.00
Labor,	250.00
Repairs,	200.00
Plant supplies,	300.00
Coagulant,	365.00
Oil and tallow,	75.00
Gas,	80.00
	\$4,082.00

More gas is used because the water is pumped twice and the filter machinery needs power. The coagulant is a part of the filter operation and so is the assistant and the analyses. The plant is being run under the supervision, order and to the satisfaction of the State Department of Health.

If books are to be kept properly and the president and the directors are to be paid for their services to which they are entitled, if a sum is to be set aside to take care of depreciation and interest and profit is to be allowed at 8%, the required income for administration would be as follows: we will say:

Administration.

Directors—3 at \$20,	\$60.00	
President,	240.00	
Secretary and treasurer,	300.00	
		<hr/>
		\$600.00
Depreciation 1% on \$69,000,		690.00
Interest and profit 8%,		5,520.00
		<hr/>
		\$6,810.00
Required income,		<hr/>
		\$10,892.00

It will be seen from these figures that the company may in the near future seek to increase its revenues. It would appear that the company could not reduce its revenues at this time. It is to be noted by reference to the new schedule of rates that stores, shops, offices and depots are charged one-half as much as a residence. The rate for a residence is \$1 per month, and at present there is no way to prevent waste of water. The object in putting in meters is to prevent waste and to make the larger user of water pay in proportion to the use. It is noted that there are 25 hydrants which afford fire protection to the community for which the borough pays the small sum of \$12.50 per year per hydrant. It would not be unjust when the matter of increased revenue comes up, to increase this fire hydrant rental to at least \$50 per year per hydrant, thus spreading the cost for fire protection more evenly over the entire community rather than on the consumers where it is now placed. In this connection, it is well to bear in mind that at least 50% of the entire cost of the water works system was incurred on account of fire protection service provided for. The benefit of this investment accrues to everybody in the community regardless of whether the property owner is a water taker or not and hence it would be fair and equitable to make the community pay for this expenditure; but of course, such an adjustment of rates would run the hydrant rental up to very much more than \$50 per hydrant per year.

A review of the meter readings indicates that in all probability the use of meters in residences will on the average, reduce the cost of water to the householders where he is now paying more than \$12 per year for water and it is believed, furthermore, that as meters are increased in number, the total revenue of the water company will be increased under the present schedule of meter rates.

In the following table is an itemized account of the abandoned property not now used or useful which was excluded from the valuation:

ABANDONED PROPERTY.

Wells:

7 wells, average 180 ft. deep—1260 ft. at \$2.50,	\$3,150.00
Well pump,	202.00
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	\$3,352.00

Pipe line to Squaw Valley Hollow:

1 Manhole,	\$30.00	
1 —3" Gate,	6.60	
30' —3" C. I. pipe at \$.26,	7.80	
50' —3" W. I. pipe at \$.27,	13.50	
1000' —4" W. I. pipe at \$.40,	400.00	
2000' —3½" W. I. pipe at \$.29,	580.00	
2440' —6" C. I. pipe at \$.50,	1,220.00	
1 —6" C. I. gate,	14.00	
1 —3½" gate,	7.00	
Trenching 5520 ft. at \$.18,	993.60	
River crossing,	800.00	
		<hr/>
		\$4,072.50

Pipe line laid in 1890 across river to springs:

1 —4" Gate,	\$8.80	
30' —4" W. I. pipe at \$.40,	12.00	
600' —4" W. I. pipe at \$.40,	240.00	
2605' —5" Wood pipe at \$.32,	833.60	
5811' —4" Wood pipe at \$.27,	1,568.97	
Trenching 9050 ft. at \$.18,	1,629.00	
River crossing,	800.00	
		<hr/>
		\$5,092.37

(All of above lines still in except under river.)

Oil well power (2 eccentric) for pumping wells at \$180.00,	\$180.00	
Concrete base 5 x 5 — 3' deep 2.8 cu. yds. at \$8.00,	22.40	
		<hr/>
		\$202.40
Total abandoned property,		<hr/>
		\$12,719.27

Discussion.

There is a lesson to be learned from this case by engineers engaged in the valuation of water works utilities, and it emphasizes the fact that large valuation cases must be considered on their own merits, and while there may be prescribed methods for making an inventory and appraisal of a property of this kind, when it comes to applying these methods to any particular case, local conditions and customs of doing business and raising money, of employment of experts, of labor and the purchase of materials and the speed with which work is done locally, must all be taken into consideration and influence the conclusions.

The experts employed by the Emlenton Water Company were skilled and experienced in the appraisal of water works and had appraised over 50 such plants in the country, so the testimony showed. But in this case, the principals of reproduction cost new less depreciation were so applied as to give a valuation in excess of what the stockholders and promoters of the company, the local citizens, believed they had invested in the utility and they were satisfied to accept the lesser valuation of the property as of today.

In this case the Commission decided that the revenues of the company were not in excess of the amount to which the company was entitled. No request was made by the respondent for permission to increase its rates. Hence the case was dropped.

THE PHILADELPHIA ELECTRIC COMPANY CASE.

Complaint was made to the Commission against the rates and service of the Philadelphia Electric Company in the city of Philadelphia, the main allegations of the complainant being that under the existing tariffs the rates were unjust, unreasonable, and discriminatory and that the service in street lighting was inadequate and insufficient.

After a number of hearings had been held, in which testimony had been presented by the complainants in support of their allegations, the company notified the Commission that it had engaged experts to prepare an inventory and appraisal of the property and that upon the completion of the same it would be offered to the Commission. Further hearings were postponed pending the completion of this work.

The Engineering Bureau of the Commission was directed to keep in touch with the work and the progress being made. The size of the property, the intricate nature of the problems involved, and the exhaustive detail with which this work of inventorying and appraising the property was carried on, warrant a brief presentation of the methods employed.

The General Situation.

The Philadelphia Electric Company operates an extensive system for the generation and distribution of electricity and gives service over its own lines in the entire city of Philadelphia and in several towns and boroughs adjacent to or near Philadelphia, including the city of Chester. The area thus served by the company is approximately 40 miles in length by 15 miles in width.

At the present time the company is supplying power chiefly from three generating stations, of which the largest and most important is located on Christian Street near the Schuylkill River. From this station current is transmitted to substations at various points in the city of Philadelphia and neighboring towns, and distributed to consumers in accordance with their varied needs.

The Philadelphia Electric Company retained the services of Messrs. D. C. and W. B. Jackson, Consulting Engineers for the purpose of making a complete detailed examination of all the physical property of the said company, including not only that portion of the property that is within the city of Philadelphia, but also that portion in neighboring municipalities where service is given by the said company. The magnitude and extent of this service has been indicated in the brief description just given of the territory served.

The inventory was begun by the company's experts on July 8th, 1914, and it was expected that the inventory and appraisal would be completed by approximately May, 1915.

The Engineering Bureau of the Commission was directed to study the nature and scope of the work undertaken by the experts retained by the Philadelphia Electric Company, early in February, 1915, and was further directed to keep in touch with the development of the work and the progress being made. Reports were submitted to the Commission in accordance with above

instructions from time to time and the following descriptions are based on said report:

Methods of Inventory.

Classification of Property.

As a basis for valuation of this extensive system, a complete detailed catalogue or inventory of every kind of physical property owned by the Philadelphia Electric Company is being made. For convenience in carrying out such an inventory the various kinds of property are being grouped into four general classes:

- I. Aerial Lines.
- II. Underground Lines.
- III. Land, Buildings and Equipment.
- IV. Other Physical Property.

Each of these main classes of property includes a large number of different kinds of material and equipment each of which will be considered in detail.

Aerial Lines.

In this class of property is included poles and other supports; pole fittings, such as cross arms, braces, guys, brackets; miscellaneous line equipment such as lightning arrestors, cutouts, fuse boxes, and the like; service fittings, such as brackets and insulators on customers' buildings; aerial wire and insulators; pole transformers; arc and incandescent lamps and their suspensions. In order to obtain adequate and correct records of all of this property, it was necessary that a personal examination be made of the company's poles and wires, by competent men who are familiar with the types of apparatus and the methods of pole line construction.

To facilitate the labor of recording data in the field and to standardize the work of the inspectors, the experts prepared suitable field forms each of which is designed with appropriate columns for recording completely appropriate and necessary data applying to the various kinds of property being listed. These forms are so complete and so comprehensive in their provisions for the recording and tabulating all data, that it is believed to be desirable to give herewith a brief description of a number of the more important ones.

Poles Sheet: To record the necessary data on poles, a form known as the "Poles" form was prepared, which form when properly filled out shows for each individual pole on any one street the stencilled number of the pole, its approximate location with respect to cross streets, the year in which it was erected (when date is available), whether it is made of wood or iron, its height, whether or not it is painted, the kind of pavement through which it is set, the number of pole steps, the number and kind of guys used to support the pole, and whether the pole is armored or not, or is set through an awning. A preliminary part of these data was obtained from office records of the Philadelphia Electric Company, namely the stencilled number of each pole, its location, height, material, and the date of erection, and this served as a guide to the inspectors in locating and identifying the property of the Company. The rest of the data were obtained from a personal examination of each pole, at which time the inspectors also carefully checked, and corrected when necessary, the preliminary data when taken from the Company's records. The heights of the poles were checked by the use of Abney inclino-

meters, with proper allowances for the depths of setting. In addition each inspector was provided with "Notes" sheets which enabled him to keep a record of any unusual features of construction.

Pole Fittings Sheet: The form known as the "Pole Fittings and Service Material" sheet is for the purpose of recording for each pole listed on the "Poles" sheet, information regarding the number, type, and size of every cross arm; the number and kind of brackets, braces and break arms; number and type of lightning arrestors, fuse boxes, arc cutouts, city test boxes, and other line equipment; and the number and kind of brackets and insulators on customers' premises. The Philadelphia Electric Company has a considerable amount of this kind of property on poles belonging to other wire companies, and on the pole fittings form have also been made records of this property for each foreign pole. The actual inspection of each pole, to record its fittings, was done at a different time and entirely independent of the inspection trip to obtain a record of the pole itself. By referring to the pole sheet and the corresponding fittings sheets, a complete detail record of every pole on the system and its equipment, with the exception of the wires and insulators becomes available.

Aerial Wires Sheet: In order to obtain complete and accurate information as to the aerial wire, the experts have taken measurements of the length between poles of every span of wire of the Company and also the lengths of spans of wire between poles and customers' premises up to the point at which the wires enter a building. At the same time these measurements were made, a plot, showing the location of each pole, was kept by the inspectors on large scale maps, with distinguishing symbols to indicate whether a pole is owned by the Philadelphia Electric Company or some other company, and whether the pole carries an arc lamp. The inspectors were accompanied by linemen who obtained the sizes of wires in each span, identified circuits, read name plates of transformers, etc. The sizes of wires were obtained from wire gauges designed so that the size could be determined from measurements of the diameter over the outside insulation or from the diameter of the bare wire. In this way it was possible to avoid cutting the insulation of wires in many cases, but wherever there was any doubt as to the correct size of a wire, measurements were taken of the diameter of the bare wire. The form on which the measurements of lengths of spans and sizes of wire was recorded is known as the "Wire" sheet, and the data show the distance between poles on a street; the number and sizes of wires in each span, classified according to the kind of insulators on each pole; and, if any, the number of cross arms on the poles which are owned by the city. In addition the experts will have complete records for every pole of the Philadelphia Electric Company of the number and kind of all attachments, except city attachments (such as fire alarm boxes, police boxes, etc.) and whether the attachment is the property of the Philadelphia Electric Company or of some other company, and also complete records of the attachments of the Philadelphia Electric Company on poles owned by others.

Pole Transformers and Street Lamps Sheets.

Pole Transformers: The experts have made complete records of every pole type transformer on the lines of the company, recording in each case the number of the pole on which the transformer is erected, the location of the pole, the make, type, capacity, and serial number of the transformer. Particular care was taken to obtain the correct serial numbers, from which the

date of manufacture may be determined. Similar sheets are used for subway transformers.

Arc and Incandescent Lamps and Suspensions: There are some 11,000 arc lamps in the city of Philadelphia, in the street lighting service supplied from overhead wires. For each of these lamps the experts have a record of the location, that is, of the pole or other structure which supports the lamp; the type of lamp; and the kind and size of the lamp suspension. They also have similar information regarding the arc and incandescent street lights in towns outside of Philadelphia.

In addition to the arc lamps in the street lighting service, there are records of the commercial lamps giving the location of each lamp, the type of lamp, the suspension, etc.

The lamps in the street lighting service which are supplied from underground cables are being inventoried on a separate street lamp sheet on which there is a record of the location of the pole, the type of pole, and whether owned by the city or the company, whether the cable is owned by the city or the company, the type of lamp and suspension and the kind of pavement through which the pole is set. Besides the "Transformers, Arc and Incandescent Lamp and Fittings" sheet and "City Arc Lamps and Supports" sheet is inserted a sheet used for field note purposes called "Record of Pole Occupancy."

Underground Lines.

In underground lines are included conduit, manholes, handholes, service boxes, underground cables, Edison junction boxes, Edison tube, subway transformers, and miscellaneous underground equipment.

It is of course necessary to rely to a somewhat greater extent on the office records of the company in making the inventory of underground construction than was the case in inventorying overhead lines, but none of the records are accepted without being carefully checked in all possible ways. The experts are satisfied that their inventory sheets will represent the underground property with fidelity.

Conduit and Manholes Sheet: The forms for recording the conduits and manholes in great detail have been prepared on which can be shown separately the length, type and size of conduit running between manholes on the system and similar information for every length of conduit between manholes and customers' premises, as well as details of sizes and construction of manholes. The conduit data are being obtained from the company's atlas maps of underground lines and will be checked by measurements on the ground. In order to obtain complete and accurate records of manholes the experts are inspecting every manhole for the purpose of obtaining detailed information regarding the size, shape, and type of construction of the manhole; the type of cover and casting; the number and type of cable racks, drains, ladders, etc. The inspectors are also making a sketch of the walls of each manhole so as to show the number, type and size of every duct opening into the manhole. If a duct is occupied, an additional record is made of the kind and diameter of the cable. From the company's office records of sizes and cables, these measurements will be carefully checked, and the lengths obtained from the conduit runs as tabulated from the maps. Records of the paving on all streets where there are conduit lines will also be made.

Edison Tube System Sheet: Detailed records of the Edison tube system (which is wholly buried) have been made from maps of the company with much care. As a check on the records, the experts are making an inspection of every junction box to obtain its location, type and size, a record of the stubs in use, and a record of the paving, which when compared with the company's records will serve as a check.

Miscellaneous Underground Equipment: Transformers in manholes are recorded with the same detail as transformers on poles on similar sheets.

Fuse boxes, oil switches, and the like on the underground lines are also all inventoried in detail. These are put on "Notes" sheets.

Cable Sheet: Detail of information about cables will be entered upon special sheets providing for the entry of lengths, locations, wire sizes, kind and thickness of insulation, and thickness of land sheath. The methods employed in determining these items and insuring their accuracy has already been referred to in connection with the "Conduit and Manholes" sheet.

Lands, Buildings and Equipment.

Land: The value of each piece of land owned in fee by the Philadelphia Electric Company is being determined by a local real estate firm working under the general supervision of the experts.

Buildings: With respect to buildings the experts are preparing for each building detailed lists of the quantities of materials entering into its construction. At the same time recording the conditions under which the various buildings were constructed insofar as they can be ascertained, the character of the soil as affecting excavation and the necessity of piling or other special foundations and similar related material.

Equipment: The inventory of power station and substation equipment and machinery is being executed in great detail. A series of separate forms have been drawn up for the purpose of listing this equipment and separate sheets are provided for each of the following types of property falling in this classification:

- | | |
|--|---|
| 1. Generators. | 9. Steam Engines other than turbines. |
| 2. Steam turbines. | 10. Condensers. |
| 3. Station Transformers. | 11. Pumps. |
| 4. Storage Batteries. | 12. Boilers. |
| 5. Switchboards. | 13. Stokers. |
| 6. Oil Circuit-breakers. | 14. Feed Water Heaters. |
| 7. Electrical Conductors. | 15. Piping. |
| 8. Miscellaneous Electrical Apparatus. | 16. Miscellaneous Mechanical Apparatus. |

The sheets just mentioned not only provide for the listing in great detail of information relative to the pieces of equipment and the conditions under which they operate, but also provide for the listing on the same sheet of estimates of cost at the factory and installed, scrap value, condition per cent and present value.

Property on Consumer's Premises.

The items of property falling within this classification are service conduits, service end boxes, meter boards, cutout boxes, meters, and in general all equipment belonging to the company but installed on the consumers' premises.

Wide differences exist in the conditions under which service is rendered to individual properties and it was necessary to develop 18 forms in order to cover the various types of installations encountered.

In general a record of the property at one installation will be recorded on one sheet, the inspector selecting the form which most nearly corresponds with the type of installation at the premises under consideration. As a guide to his selection of the proper form, each sheet has a diagrammatic sketch of the type of installation, the field record of which should be made on that form.

There are certain general features common to all the forms, and the inspectors are directed to make an entry after every heading. If there is no equipment corresponding to a certain heading, the inspector makes a dash after that heading. Under remarks a record is to be made of cut-out boxes, switch boxes, service end boxes, etc., found unsealed, difficulties encountered and conditions met with that are out of the ordinary.

In the following pages will be found a description of these forms as well as the classification used:

Class 1 A. C.:—A. C. Underground Service from Aerial Lines: This form is used in recording the property of the company on the premises of consumers where the installation is of the type illustrated at the top of the form, the line conduits running through the basements from house to house. This construction is encountered chiefly in the "operation" houses so numerous in West Philadelphia.

It will be noted, that in addition to general information relating to the consumer and to the premises, the form provides for a record of the size and length of all conduit, of all conductors, the location and the type of meter boards, and of cut-out boxes, complete meter data, ground wires, miscellaneous property and also makes ample provision for noting unusual conditions or features of installation. It also shows diagrammatically the general nature of the installation and the various types of meter board, thus ensuring uniformity in classification and in recording.

Class 2 A. C.:—A. C. Underground Service from Aerial Lines: The type of installation shown on this form is also very frequently encountered in West Philadelphia. The installation consists of an underground service terminating in a vault, with the service conduit brought through a division wall to reach the meter board, on which is mounted a single meter. The service may connect directly aerial lines or may connect with local underground lines connected with aerial.

Class 3 A. C.—A. C. Underground Service from Aerial Lines: This form is quite similar to the form used for installations listed in Class 2 A. C. The service may connect directly with aerial lines or it may connect with local underground lines connected with aerial lines. The installation consists of an underground service passing through two walls to a service end box, a service conduit to the meter board, on which is mounted one meter and the usual accessories. The form is also used where there is no vault and the underground service simply comes through one wall.

Class 4 A. C.:—A. C. Service from Aerial Lines—Installations of one Meter: The data called for on this form is practically the same as in the three preceding forms. It is to be used to record property in the case of installations consisting of one meter receiving service directly from aerial lines—as shown

in the diagram at the top of the form. This type of installation is a very common one for small consumers and will be found in all sections of the territory served by A. C. aerial lines. The meter may be located in various places regardless of where the aerial service enters the premises.

Class 5 A. C.:—A. C. Service from Aerial Lines—Installations of two or more Meters: The type of service is similar to Class 4, except that there are two or more meters instead of only one and that a service switch may be installed. The class of customers using this service are business establishments, churches, small theatres, etc. It will be noted that the form differs from the preceding ones, that provision is made for recording property belonging to the consumer and that several additional items must be observed and recorded.

Class 6 A. C.:—A. C. Underground Service from Aerial Lines—Installations of two or more Meters: This type of service is similar to Classes 2 and 3, except that there are two or more meters instead of one meter, and that a service switch is installed. There may be a vault as in Classes 2 and 3, in which case the inspector should indicate the position of the vault on the sketch.

Class 7 A. C.:—A. C. Service from Aerial or Underground Lines—Open Wiring from Service Entrance to Meter: This class of service represents the older type of installation before standard equipment and standard methods of assembling equipment were adopted by the company. The method of running the wires into the building, the location of cut-outs and service switches, the location of the meters, etc., will naturally vary widely. The data to be recorded is similar to that recorded in the preceding classes.

Class 8 A. C. Aerial Service, Class 9 A. C. Underground Service: These two classes of installations are used largely in serving apartment houses, business establishments, theatres, etc., etc. The service may be 3, 4, 5, 7, or 9 wires or may be a combination of two services. Additional items provided for cover meter frames, bus wires, size and number and kind of cables entering building, etc.

Class 10 A. C. Aerial Service, Class 11 A. C. Underground Service—Meter Frame with Enclosed Busses and Open Wiring: These two classes of installations are also used for serving apartment houses, business establishments, theatres, etc., etc., differing from Classes 8 and 9 in the method of running the bus wires. In Classes 10 and 11 the bus wires are carried in closed conduit through the cut-out boxes. The data to be rendered is similar to that for Classes 8 and 9.

Class 12 A. C. Aerial Service, Class 13 A. C. Underground Service—Meter Frame with Enclosed Busses and Type "B" Meter Board Units: The data, with the variations caused by the use of "Type B" meter board units, are exactly similar to that called for under Classes 8, 9, 10 and 11.

Class 14 D. C. Underground Service—Installations of One Meter: This class of installation is used for residences and for small business establishments. The information to be recorded on this and the following D. C. forms is in general similar to that called for on the forms for A. C. installations with the exception of the variations due to the use of the direct current meter instead of the alternating current.

Class 15 D. C. Underground Service—Installations of Two or More Meters: In general this class of installation is similar to Class 14 except that there is more than one meter, that there may be a service switch installed and that the service switch may be in a vault as indicated in the diagram.

Class 16 D. C. Underground Service—Meter Frame with open Busses and Open Wiring: With the exceptions caused by the fact that the service is always from underground lines and that the meters measure D. C. current, this class of service is similar to Class 9 A. C.

Class 17 D. C. Underground Service—Meter Frame with Enclosed Busses and Open Wiring: This class of installations is similar to Class 16 except that the bus wires in this class are carried in closed conduit running through the cut out boxes.

Class 18 D. C. Underground Service.—Meter Frame with Enclosed Busses and Type "A" Meter Board Units: Similar to Classes 16 and 17 except variations caused by the use of type "A" meter board units.

Other Physical Property and Miscellaneous.

Other Physical Property: In this class of property is included all such items of physical property not already provided for, such as transportation equipment, furniture and fixtures, and supplies of all kinds. For convenience of locating and identifying certain of these items, the experts must naturally depend to some extent upon lists prepared by the company, but such lists are always carefully checked either as a whole or in sufficient proportion to satisfy the experts that the property is correctly represented.

Compilation of Inventory Data: In the actual work of inventorying all of the above classes of property, a geographical separation is also being made between the city of Philadelphia and the various towns outside, so that the experts may be prepared to state the amount of property in each locality, detailed according to the four classes described above. The very large number of individual field sheets resulting from the inventory have of course to be added, the totals transferred to tabulating sheets, and in turn carried to cost sheets in such form that the clerical work of applying unit costs may be readily done. To facilitate the work of tabulation and to prepare the results for the ready application of unit costs a number of special forms were prepared by the experts, the general character of the forms being in harmony with the field forms already described and discussed.

Additions and Removals of Property: As changes in the property of the company occur from day to day, it is desirable to bring all the inventories of the different kinds of property to one date. Consequently, it is necessary to keep separate records of all additions or removals which may occur between the time the property is actually inspected by the experts and the date determined upon for the completed date of the inventory. These records are being kept in the work departments of the company in such form that the experts are able to transfer them to the inventory sheets. In addition a portion of the records are being checked by inspection in the field.

Instruction to Inspectors.

The direction of the vast and complicated work of inventorying and appraising this large property naturally depended upon the efforts of the experts themselves and the men forming part of their regular organization. The field work incident to inspecting and listing the thousand of items of property and the office work incident to the tabulation and preparation of the data gathered in the field naturally called for the employment for these special purposes of men of varied experience and qualifications for the purposes of insuring uni-

formity in results and accuracy. Detailed directions were compiled by the experts describing the various forms to be used and the manner of their use together with directions of a general nature. The character of these directions may be judged by the following examples:

Instructions to Inspectors of Pole Lines: The work to be done by the inspectors of pole lines covers the making of a catalogue of the property of the Philadelphia Electric Company in overhead lines, including poles, fittings, wires, transformers on poles, arc lamps, arc suspensions, etc. The work should be carried on with the least practicable interference with the regular duties of the company's other employes and in a quiet and unostentatious manner.

Before beginning the work of cataloguing, each inspector should study carefully the printed form provided for recording the several kinds of property which he is directed to catalogue, and make himself thoroughly familiar with not only the headings of the columns but also with the order in which they are given on the form. The purpose of the forms is to enable the inspectors to list the various items of property as rapidly and with as little labor of recording in the field as possible. The territory covered by the company's pole lines is divided by the company into "Districts" and for convenience in cataloguing, the districts have been sub-divided into "Sections." The inspector should become familiar with the section in which he is to work by studying the map before beginning the field work.

These general directions are then followed by a detailed description of the forms to be used and the manner of their use. Twenty-five typewritten pages are required for these directions.

Instructions to Inspectors of Manholes: The work to be done by the inspectors is the making of a complete record of each manhole and handhole, including not only the details of construction of the manhole itself, but also a record of the conduit opening into the manhole and the cables entering or leaving the manhole.

The directions then indicate the methods to be used in sketching the manholes and the arrangement of the ducts and cable racks and listing the various items of equipment usually found in manholes. Provision is also made for listing the cables and their location with respect to the appropriate duct numbers. Reference is made to the various forms developed for this purpose and to the manner of their use and about five pages of typewriting are necessary therefor.

Instructions to Inspectors of Generating and Sub-Station Equipment: A general inspection of the grounds, building, and equipment must be made before starting to prepare a detailed catalogue of any part of the property. For generating stations, this inspection should cover the whole plant from coal receiving docks and railroad sidings and the intake for circulating water for the condensers to the outgoing feeder terminals or potheads. For sub-stations the inspection should cover the plant from the incoming to the outgoing feeder terminals or potheads. A memorandum for filing with other Notes must be made first of the location of the property, giving the district in which it is situated and the approximate location by street boundaries (if any), its location with respect to railroad and water transportation, the total K. W. capacity of plant, the class of service furnished, that is, whether for generating or sub-station purposes, and whether for railway or for light and power, its location with respect to manufacturing and residential districts, and its approximate relation as regards distances to the main centers of load

distribution. The approximate area of the property should be given, accompanied by a sketch, together with a list of the buildings and the approximate ground area occupied by each; also the approximate heights of the buildings from ground level to the roof trusses, and materials of construction for walls and roof of each, and the number, heights, diameters and materials of construction of stacks. The character of the soil should be specified, and in a general way the foundations for the main buildings described, that is, whether built on piling or otherwise, with approximate average depth from the surface to the bottom of the foundations. These Notes should also include in addition to the general description of the buildings and service supplied, a brief outline of the main parts of the equipment and their general location as follows:

Give the approximate floor area and dimensions of the boiler room and height from floor level to bottom or roof trusses. Give the number of boilers and type (water or fire tube) and nominal rating of each and of total, together with arrangement of batteries, and brief descriptions of breechings and flues connecting to stacks; method of firing boilers, that is, whether hand fired or by mechanical stokers, and the make of the stokers. Describe coal bunkers (if any) over the boiler room and the approximate capacity. Give a general description of the coal handling machinery, stating name of maker of main apparatus, such as coal elevating, crushing, conveying and distributing machinery, giving the type of hoist, type of conveying apparatus, whether cars, screw conveyors or bucket conveyors, together with the method of handling coal to and from outside coal storage yards; also state whether coal is delivered to the plant by boats, cars, or wagons, or combination of these methods. Describe briefly the ash disposal equipment, and state whether the ashes are dropped from below the boilers or handled on the level of the boiler room floor, giving the type of conveying equipment, whether cars or conveyors, and whether the ashes are delivered to cars, boats or wagons for hauling away from plant, or for disposal on the premises for filling in low land.

State approximate dimensions and floor area of engine and generator room, height from floor level to bottom of roof trusses. Give the number, location and dimensions of galleries for switching and other equipment; number K. W. or K. V. A. capacity of direct connected engine or turbine units; H. P. of engines belted to generators and K. W. capacity of the generators, number and capacity of the exciters, exciter battery, capacity and location; also location, number and capacity of other equipment items, such as main transformers, motor generators and rotary converters, and main switch-boards, with number of panels. Give a brief description of travelling cranes, including capacity and span. Also brief description of engine room floor, giving construction material.

State approximate dimensions and floor area of engine room basement, and height from floor to ceiling. Describe briefly intake and discharge system for condensed circulating water, giving general description of tunnel and of main intake and discharge pipes, if tunnels are not used. Give description of fore-bay and approximate distance from building. State number, type and capacity of the main pumps for condenser circulating water, and give number, make, type, and brief description of condensers.

For sub-stations a brief description of the principal items of the equipment and location should be given in a similar way to that outlined above for generating stations; the description should include floor area and the dimensions of the main rooms and basement, floor construction, general type of

foundations, whether forming a part of the building proper, as in recent construction, or separate from it; number, type, capacity of main units, such as main step-up and step-down transformers, rotary converters, motor generators and storage batteries, and location of main switchboards and number of panels.

Supplementary to the above description a list of the equipment contained on the grounds and in each building should be prepared, classifying the equipment according to the location on the property, and according to the rooms, floors and galleries of the buildings. This list is not in any sense intended to be a complete catalogue, the purpose of its preparation being to provide means whereby at a glance any person not familiar with the station may obtain an approximate idea of the main items of equipment which it contains.

Sketches are to be prepared in the field drawn as carefully as time will permit, but not to scale, showing the locations of the main apparatus as listed above, arranged by buildings, rooms, floors and galleries. The main equipment outside of buildings, such as that for coal and ash handling, including outside coal storage, wharves and railroad siding and trestles, circulating water intake and discharge tunnels or pipes, forebays and screen houses, etc., should be drawn on these sketches with approximate overall dimensions and location with respect to the station buildings. Drawings will be obtained when available for the guidance of inspectors making these sketches. Other drawings to scale, showing the general arrangement of buildings and equipment based on these sketches and such other drawings as may be available will be prepared later, but are not to be considered as a part of the field work.

An accurate survey of the land will not be taken under this inspection; however, from such drawings of the property as may be available and from field Notes, the inspector will be required to make a sketch of the property, which is to accompany the preliminary notes as above described.

A detailed survey of the buildings will not be included in this inspection, further than required for the brief descriptions outlined above to accompany the preliminary notes.

A brief history of the station will be required, that is, to the extent that the inspector can obtain this information from the chief engineers in charge, whose knowledge of such matters should cover the buildings and equipment, and which is as far as the field inspector will be expected to go in this matter. Ascertain, if possible, the date of the construction of the first buildings, with the total H. P. or K. W. capacity of the original equipment, and the class of service supplied, changes and additions to the original buildings, with dates, together with information as to the main apparatus removed and additions to the same, with the date, capacity and service applied. This relates to only the main buildings and equipment, such as boilers, engines, turbines, main transformers, converters and motor generator sets. The information here noted is intended to serve as a general check on determining the age of present buildings and equipment, the condition of such and other matters of a like nature.

For the preliminary data, as above outlined, the average stations should not require more than two day's time for one man. Note Sheets, Form No. 1657 and Sketch Sheets, Form No. E-185, are to be used.

All inspectors are warned to use the utmost care to avoid coming in contact with any parts of the equipment that may in any way injure them. This applies to all apparatus, whether mechanical or electrical, but especially to such electrical apparatus as may at any time be a conductor of current.

Warning signs are generally placed throughout the stations at points of danger, but these are oftentimes not sufficient to prevent accident. Should it be necessary to go in close proximity to any high tension apparatus or back of any high or low switchboard, a visual inspection must be sufficient. Wires or cables in such cases should not be measured, and if the sizes are not available from drawings they may be estimated and at the same time checked by inquiries made of responsible employees.

The directions then proceed to discuss in detail and at considerable length the forms developed for cataloguing the standard items of equipment and the manner in which these forms are to be used. Approximately 23 pages of type-writing are required for this part of the directions and for the presentation of the classification scheme forming the basis of the catalogue.

Instructions to Inspectors of Property on Consumers' Premises: The work to be done by the inspectors of property on customers' premises comprises the making of a catalogue of such property of the Philadelphia Electric Company as service meters, meter supports, conduits, switches, cutouts, fuse boxes, transformers and transformer houses located on the premises of customers, lengths and sizes of cables and wires which are used in making connections with the outside services wires, etc., etc.

In addition to cataloguing the property, the inspector is to make careful notes of any installations which are not in proper condition. The most important thing to detect is the use of current which is not metered, which may occur both at premises where there are no meters and also at premises where there are meters installed, but so connected that all current is not being properly registered. Other things that the inspector is to observe and make a note of are installations where the inside service wires are left hanging at premises where there are no meters at present, improperly sealed switch-boxes or cut out boxes from which unmetered current could be taken off, etc.

For convenience in cataloguing, the territory to be covered will be divided into the Districts and Routes which are followed by the Meter Department; and the inspector, before starting field work, should make himself familiar with the geographical outlines of the route or routes to which he is assigned, and also whether the customers in the route are business or residential customers, and whether the premises are served by overhead wires or underground cables. In order to record most of the information desired, it will be necessary to obtain entrance to the customers' premises. The only authority which the inspector will have to show is the regular Company Badge. The property to be inspected may be located in basements, attics, or even in rooms occupied daily. It is *particularly important*, therefore, that the work of inspecting be carried on in the least obtrusive way, and in a manner which will not cause annoyance to customers of the company. The inspector should not be over insistent on his right to enter the premises, but may suggest that the customer telephone to the company to "Mr. Jackson's Department" if necessary to confirm his authority. If questioned in regard to his work, the inspector should say that the company has been ordered by the Public Service Commission to make an inventory of its property, and that he is employed by the company to obtain a record of its meters and other property on the premises.

As far as practicable, each inspector will be assigned to routes in one district. He will be provided with maps of the route of sufficiently large scale to show the house numbering of each block, and on these maps will be marked the address of every building where the company has a meter installed, the number of meters and their location in the building, and the ad-

dress of every building which is connected to the underground lines of the company, as far as this can be ascertained, whether there is a meter installed on the premises or not. The inspector will then visit the premises of every address marked on his map, but he is to do this taking each city block as a unit and completing the inspection of that block before proceeding to another block. The reason for this method is that in addition to the addresses which are marked on the maps as meter locations, there are many places where the company owns property such as conduit, switches, meterboards, etc., and the inspector is also to obtain a record of this property wherever it can be located. As the company keeps a careful record only of its active meter installations, there are little data available as to the locations where there is property such as above but no meter, except data shown on the maps of the conduit system which are incomplete. The data so far as known, however, will be entered on the inspectors' field maps as indicated above. Other locations of this type will have to be determined by the inspector, in the case of blocks served by overhead wires, by observation of the outside of buildings, following service wires, etc., and in the case of blocks served by underground cables, by house to house visits in certain sections of the city. In the so-called "Underground District" of the city between Vine and South Streets this house to house search will not be necessary.

In outlying districts served by aerial lines the inspector should follow primary and secondary wires to the ends of circuits whether there is a meter installation marked on his map or not. In all districts served by aerial wires the inspector should watch carefully for underground services from the overhead wires.

The inspector should inspect each block, taking each address which he will have marked on his map in order along the block. If in an overhead district, he should at the same time observe the outside of each building not marked as a customer of the company for service wires or building entries which would indicate that these buildings have been connected to the lines of the company, and such premises should then be inspected in the same way as the regular customers. He may come across three conditions: viz, first, the service wires may not have been disconnected from the premises at all; second, the service wires may be disconnected between the service bracket and the point of entrance to the building; third, the service wires may have been removed between the pole and the service bracket. In the first two cases where the service spans are still in position, it will be comparatively easy for the inspector to locate the buildings which are not listed as customers at the present time but may have property of the company installed on the premises; but in the third case the inspector can only tell by noting whether there is conduit pipe on the building, service brackets, etc. Such property of the company as may be found in these locations determined as above should be recorded by the inspector with the same care and detail as that in the present customers' premises as will be explained later. As mentioned above, there are certain streets in the city served by underground lines where it will be necessary for the inspector to make an inspection of the basement of each building along the street whether there is a meter installation or not, in order to get a complete record. To obtain entrance to the premises of buildings which are not served by the Philadelphia Electric Company, and possibly never have been served either by the Philadelphia Electric Company or by one of its predecessors, will be more difficult than inspecting the premises of the company's regular customers, but the inspector should try to make the search as complete as possible, being careful however not to cause annoyance and trouble. He should keep a daily record of all buildings to

which he is not able to obtain entrance, both those on the regular customers' lists, and those where there is no meter but may have other property on the premises, and he should also note the reason that he is unable to make the inspection.

The inspector will be provided with a badge, flash light, calipers, six-foot rule, a sealing outfit, samples of the different sizes of wire in use, photographs of the standard types of apparatus giving dimensions of cut out boxes, switches, etc., and a table giving the outside diameters of the various sizes of conduit in use, so that he will be able to readily recognize the different kinds of property.

There are a number of types of meter installations in use by the company and also a large number of installations where there is no definite assembling of the apparatus in cases where the services have been installed for a considerable period. The company distinguishes between a "primary service," that is a service where the transformers are located on the customers' premises; a "secondary service" where the alternating current secondary wires are carried to the meter directly; and a "direct current service." As the primary services are few in number and include considerable apparatus, much of which is of a special nature, the instructions given herein apply chiefly to the work of recording the secondary and direct current services. The primary services will be recorded by special inspectors who will work in conjunction with employes of the meter department who are familiar with the character of each installation and can supply information as to the details of the construction and ownership of the apparatus, as in many cases certain parts of installations are paid for by the customer.

As is usually the case in a company of the size of the Philadelphia Electric Company and a company also which is a consolidation of several predecessors companies, each of which had varying standards of construction, there are many different types of apparatus and methods of assembling the equipment on customers' premises.

During recent years, however, the Philadelphia Electric Company has largely standardized its apparatus and methods of installation and it is possible to group these standard installations, and also in a general way the older methods of installations, into several classes.

The directions then discuss the various forms developed and the manner in which they are to be used. First, in general and then with particular reference to each of the 18 classes into which this particular portion of the property has been divided. The completeness and the detailed consideration given these directions may be judged by the fact that approximately 30 pages of typewriting are necessary for their presentation.

Exhibits of Equipment: In addition to supplying their inspectors with carefully planned forms for the recording of the various items of property, and with detailed descriptions of these forms, and detailed directions for their use, the experts have arranged a series of exhibits of the various forms and types of equipment likely to be encountered. These exhibits are used in instructing the inspectors so that they will be perfectly familiar with the various types of equipment to be met with before they begin their field work. Photographs of these exhibits are carried by the inspectors in the field for the purpose of enabling them to accurately identify and classify the various types of equipment as they are encountered.

Methods of Appraisal.

With the exception of land which is to be valued as hereinbefore described, the labor and material costs of the entire property will be obtained by applying carefully chosen unit costs to the inventory quantities.

The proper unit costs to be used are to be determined after a study of the conditions under which construction work would be carried out in Philadelphia, the length of time required for the execution of the work and the character of the labor available. For ordinary materials, the prices of which change relatively little or only a gradual change in one direction, the unit prices will be based on the prevailing prices for such materials at the time the inventory is carried out. In the case of certain materials such as copper, which is subject to wide fluctuations in price, the experts use unit prices which represent the average of market prices taken over several years. Associated with the cost of the bare material is also the cost of delivery at the place where the material is to be used, the cost of inspection, storehouse charges, the labor of erection, tools and incidentals, allowance for lost time, watching, etc., all of which are being considered by the experts in arriving at the fundamental labor and material cost.

General Procedure.

A part of the work of inventorying a property consists in collecting and classifying the various items of property belonging to the company and determining the qualities involved in each division. By applying to the quantities properly determined unit costs and percentages covering supervision, engineering, organization, etc. the experts will determine the cost of the physical property. In their consideration of this problem they sub-divide the item "unit costs" into cost of material and cost of installation, in which is included the costs of all labor entered to installation up to and including foremen. The first step towards obtaining the above mentioned unit costs has been to prepare from the inventory data lists of materials and items involved, and to obtain from the purchasing department of the company the names of the various firms from whom such materials were usually purchased. This information is arranged in groups according to the classification adopted for the purposes of inventory and appraisal, and the sheets containing the same arranged in book forms. This arrangement of the information facilitates the work of entry into the voucher books of the company. In the case of firms such as the Westinghouse Electric and Manufacturing Company, from whom a very varied list of materials would be purchased, it is customary to make a similar list for this one firm, the general purpose of the combination being to act as a guide to the voucher books.

The next step in this work is to prepare for each class of property or each group of items forming an element of plant a list of the data needed to make up the unit cost of such element. This list is also used in planning and directing the work of search for prices and costs.

In the collection of the information outlined above it has proven desirable to use special printed forms in order to facilitate the work. The forms contained headings for entering the name of the article, the catalogue or bulletin reference, the sources of information from which the price, discount, freight, weight, etc., have been obtained; in addition the forms give for each of these items the number of pieces involved, when and where installed, and a particular reference to the inventory record.

Summary Sheets.

In many cases special summary sheets have been made up giving the cost of material, catalogued in tabular form, under headings similar to those used in the summary sheet for cross arms for wood poles:

"SUMMARY SHEET."

"Cross Arms."

Class of Arm	Number of plus on arm.	Arms.	Plus.	Pinning and painting.	Accessories, bolts, etc.	Total cost of material.
1.	2	.39	.019	.11	.165	.684
2.	etc.	etc.	etc.	etc.	etc.	etc.
3.	etc.	etc.	etc.	etc.	etc.	etc.
4.	etc.	etc.	etc.	etc.	etc.	etc.
5.	etc.	etc.	etc.	etc.	etc.	etc.
Etc.,	etc.	etc.	etc.	etc.	etc.	etc.

Summary Sheets have been developed for poles, cranes, and other elements or groups of items as may be considered as belonging together and forming a distinct element of plant. The installation costs are assembled in a somewhat similar manner and when approved are combined with material costs to give a final first cost.

Tally Sheets, showing in considerable detail the various steps involved in the determination of the unit costs, are kept in the office, and are of great help in directing the work and in furnishing a record of progress being made, in addition to showing by whom and when the work was done, these sheets indicating the two main divisions, material and installation, under each of which sub-headings are given the headings "Date Needed," "Company's Prices," "Estimates," "Summary," and "Approved."

As a further illustration of the items taken into account in determining unit costs, we can consider the item of wood poles. The company buys all its poles f. o. b. Philadelphia, and before a pole has been erected ready for use, the following work has been done upon it: Unloading, shaving, gaining and roofing, hauling, painting, digging, erecting, installing. Furthermore, other charges accruing against all poles purchased by the company cover inspection prior to shipment, storage, breakage, and tools. In addition to the above items of cost applicable to all poles, a certain number of poles, of a given size may have had special painting done upon them; others may have been stepped or equipped with guards, and still others may have been set in concrete, or may have been set in a certain kind of pavement, or through an awning. The cost of these processes must be determined as unit costs for such processes, and must then be applied to the final summary sheets of the inventory, which sheets in turn must indicate the number of poles in each class against which such special charge properly lie.

As already mentioned the final presentation sheets really combine inventory and appraisal data, and the character and arrangement of the material on these sheets are illustrated by the following table applicable to wood poles. The actual tables naturally vary very much from the proportions of the table as given below but the headings indicate the data to be examined:

**"INVENTORY AND APPRAISAL OF WOOD POLES INCLUDING
STUB AND BRACE POLES AS OF DECEMBER 31st, 1914."**

Length of pole,	15	20	25	30	Etc.	Etc.	Totals.
-----------------------	----	----	----	----	------	------	---------

Philadelphia County:—

District A —

District B —

District C —

District CK—

District D —

District DC—

District E —

Etc.—

Fairmount Park—

Total in Philadelphia County—

Adjacent to Philadelphia County—

Unit Cost—Labor & Material—

(With reference to sheet giving its development and to summary sheet given, and of poles so treated, etc.)

Total Cost—Labor & Material—

(With reference to sheet giving its development and to summary sheet given, and of poles so treated, etc.)

Additional Cost of Painting—

(With reference to sheet giving its development and to summary sheet given, and of poles so treated, etc.)

Additional Cost of Setting these streets
and sidewalks—

(With reference to sheet giving its development and to summary sheet given, and of poles so treated, etc.)

Additional Cost of setting these awn-
ing—

(With reference to sheet giving its development and to summary sheet given, and of poles so treated, etc.)

Additional Cost of Concrete Settings—

(With reference to sheet giving its development and to summary sheet given, and of poles so treated, etc.)

Additional Cost of Armoring—

(With reference to sheet giving its development and to summary sheet given, and of poles so treated, etc.)

Additional Cost of Stepping—

(With reference to sheet giving its development and to summary sheet given, and of poles so treated, etc.)

Total Cost—for labor and material.

The sample table presented above covers the inventory and appraisal of the poles belonging to the Philadelphia Electric Company and located within the limits of the city of Philadelphia. A companion table built up on the same general lines lists all of the Philadelphia poles under the heading of the Philadelphia Electric Company and lists the poles outside of Philadelphia under the names of the respective companies. The totals on this second sheet giving the total number and total unit cost of poles belonging to the Philadelphia Electric Company regardless of their location relative to the city limits of Philadelphia.

Organization Required.

It is believed that a brief description of the organization necessary and the time required to carry on an undertaking of this kind will be of general interest. The inventory was begun by the experts on July 8th, 1914, and it was believed at that time that it would be completed by the latter part of May or the first part of June, 1915. On February 10th, 1915, forty-two men were engaged in prosecuting the work. The following table shows the average number of men engaged per day for each month:

FORCE ENGAGED ON INVENTORY AND APPRAISAL IN THE PHILADELPHIA ELECTRIC COMPANY'S EMPLOYMENT.

Month.	Average Number Engaged per Day by Each Month.			Total.
	Jackson force.	Regular Employees of Company.		
		Linemen.	Underground labor.	
1914.				
July,	11	.....	.....	11
August,	19	.....	.....	19
September,	22	6	.....	28
October,	25	11	.....	36
November,	28	5	3	36
December,	30	4	8	42
1915.				
January,	31	.....	11	42
February,	33	.....	9	42

The linemen and laborers have acted simply in the capacity of helpers to the special force of inspectors employed by the experts conducting the appraisal.

On April 11th, 1915, the organization actively engaged in the work of the inventory and appraisal had grown to 50 men and this number does not include a varying number of employees of the Philadelphia Electric Company used as helpers and guides. The progress made in the interval was so satisfactory that it was still believed that the work would be completed by June, 1915.

On June 15th, 1915, the organization employed by the experts totaled 52 men and good progress was being made. It had been evident for some time that the inventory and appraisal could not be completed within the time limits originally specified and at this time it seemed probable that at least

two more months would be required to complete the work and prepare it for presentation to the Commission.

Summary.

It will therefore be seen that at the close of the fiscal year much work remained to be done. The Bureau while not actively engaged in the work of the inventory and appraisal, kept in close touch with the situation. As before stated, much of the foregoing has been presented in view of the size of the property, the complexity of the problem and the degree of detail with which the work was carried out.

Attention is here directed to the fact that some of the exhaustive detail, particularly in connection with the property on consumers' premises, was for the purpose of collecting information and data for the use of the Philadelphia Electric Company rather than for purposes ordinarily considered necessary in connection with an appraisal for rate making purposes. An idea of the magnitude of the task may be obtained from the fact that the company has about 45,000 installations on consumers' premises and has about 70,000 meters set in these installations. The excess in the number of meters is due to the installation of more than one meter in a single property in certain classes of service.

One of the branches of the case had to do with the adequacy of the units used for street lighting and the price per year paid therefore by the city of Philadelphia. In anticipation of the consideration of this problem by the Commission, the Engineering Bureau was instructed to make a study of the general problem of street lighting. Information was sought for municipal authorities, from technical publications, from manufacturers, and from utility representatives, relative to the general practice in various cities and towns throughout the State and the country, with particular regard to the type of unit used, the price paid therefor per year, the outages encountered and the general cost of operating. This work was well under way but not yet completed at the close of the fiscal year covered in this report.

MINIMUM METER RATE.

THE NEW CHESTER WATER COMPANY.

In this case the city of Chester et al. vs. the New Chester Water Company, the complaint is against the minimum meter rate and against the rules of the company included in a new schedule of rates and changes governing the service at Chester City, Pa., which became effective June 31, 1913, pursuant to the requirements of the Public Service Commission law. The matter was referred to the Chief of the Bureau of Engineering for a conference with the parties in interest. Meetings were held and an agreement was entered into and a report submitted recommending that the Commission find, determine and order the Water Company:

1. To furnish water by meter only to its consumers except for public fire protection.
2. To adopt and put into effect the following rules with respect to meter service:

a—The water company will furnish water to any tenant, with the consent in writing of his land-lord or his duly authorized agent and agreement to comply with rule (d) herein. The tenant shall pay for the water in accordance with the rules, rates and regulations of the water company and make the deposit therein required.

b—The water company may require each and every tenant, consumer of water to make a deposit as security to cover the payment of bills for water consumed and damage to meters occasioned by negligence of consumer, before water is turned on. Interest shall be paid on deposits at the rate of 4% per annum.

Said deposits shall be based on size of meters not exceeding as follows:

$\frac{5}{8}$ inch meter,	\$3.00
$\frac{3}{4}$ inch meter,	10.00
1 inch meter,	12.50
1 $\frac{1}{2}$ inch meter,	15.00
2 inch meter,	17.50
3 inch meter,	20.00
4 inch meter,	22.50
6 inch meter,	25.00
8 inch meter,	30.00

c—Meters to be read monthly and bills presented monthly.

d—The land-lord or his agent shall give notice to the water company of any change of tenant of which he has knowledge so that the meter may be read and removed, and upon failure to do so, to be responsible for all water rent subsequently accruing under schedule rates until a new contract is entered into with the new tenant.

e—No water to be furnished to any consumer while indebted to the water company for unpaid water rent.

3. To change, modify or amend as far as may be necessary all other rules of the company to make them conform to said rules in the preceding section respecting meter service.
4. To adopt and enforce the following monthly minimum meter charges, based upon the size of meter required and installed and the stated quantity of water allowed.

MONTHLY MINIMUM METER CHARGES.

Size of Meter.	Minimum Monthly Rate.	Number of Gallons of Water Allowed for the Minimum Rate.
3" to 5",	\$0 50	1000 gallons or less per month.
5" to 8",	1 00	1001 to 3333 gallons per month.
8" to 10",	1 50	5000 gallons or less per month.
10" to 12",	2 00	6666 gallons or less per month.
12" to 14",	2 50	8333 gallons or less per month.
14" to 16",	3 00	10000 gallons or less per month.
16" to 18",	4 00	13333 gallons or less per month.
18" to 20",	5 00	20000 gallons or less per month.
20" to 22",	7 00	25000 gallons or less per month.
22" to 24",	10 00	50000 gallons or less per month.
24" to 26",	12 00	60000 gallons or less per month.

5. To adopt and enforce the following schedule of meter rates:

SCHEDULE OF METER RATES TO BE CHARGED PER 1,000 GALLONS OF WATER CONSUMED WHEN THE AVERAGE DAILY CONSUMPTION IS AS FOLLOWS:

Quantity of Water in Gallons.	Rates per 1000 Gallons.
First 500 or less	Per 1000 gallons, \$0.30
Next 500 to 1000	Per 1000 gallons, ..... .25
Next 1000 to 2000	Per 1000 gallons, ..... .20
Next 2000 to 5000	Per 1000 gallons, ..... .17
Next 5000 to 10000	Per 1000 gallons, ..... .15
Next 10000 to 25000	Per 1000 gallons, ..... .12
Next 25000 to 50000	Per 1000 gallons, ..... .10
Next 50000 to 100000	Per 1000 gallons, ..... .09
Next 100000 to 142857	Per 1000 gallons, ..... .07
Next 142857 to 285715	Per 1000 gallons, ..... .06
Next 285715 to 428572	Per 1000 gallons, ..... .05
Next 428572 to 857144	Per 1000 gallons, ..... .045
Next 857145 and over	Per 1000 gallons, ..... .04

In the following pages will be found a description of the water works, an account of the two conference meetings and other relevant data.

The Physical Plant of the Water Company.

The New Chester Water Company's Operations at the Present Time.

The New Chester Water Company directly or indirectly supplies water to the city of Chester, Upland Borough, Lower Chichester Township, Chester Township, and Marcus Hook and Eddystone Boroughs. This has been accomplished by reason of either purchase or merger, so that in addition to its own charter territory, the other sections in the vicinity of Chester city are being supplied with water by the New Chester Water Company through the pipe lines of water companies incorporated by men interested in the New

Chester Water Company. In this way the water filtered and finally treated with a chemical germicide is served to the public in Chester Township through the Edgemont Water Company, to Marcus Hook Borough through Chichester Water Company, and to Eddystone Borough through Ridley Water Company.

In 1866 a large majority of property owners in the South Ward of the city of Chester voted for a domestic and fire protection supply of water. In the following year a law was passed authorizing the members of the city council of the said South Ward or a majority of them or their successors to contract for the erection of works to supply the said South Ward or the inhabitants thereof with an adequate supply of water and for the purpose, power was given for the parties to occupy the roads of Delaware County, the streets of the city, the streets of the said South Ward and other property in said county, city and ward with the same rights and privileges and subject to the same restrictions, as are now by law given to and imposed upon water companies in the Commonwealth.

The water works, privileges, revenues and franchises were the property of the South Ward and its inhabitants. The security for the payment of the loan contracted for the erection of water works was all the property in said South Ward, real, personal and mixed. In 1887 the New Chester Water Company bought out the South Ward water works, paying for the system, so it is reported, \$313,000.00.

The City of Chester is a manufacturing community and historical town located on the north bank of the Delaware River in Delaware County a short distance above the Delaware-Pennsylvania state boundary line and about nine miles down stream from the mouth of the Schuylkill River in Philadelphia.

Within the charter territory of the Water Company, which is quite flat and extends along the river bank, for a distance of three miles, there is a population of 40,000 people or thereabouts. The city is in a thriving condition, its industries which are varied, among which are the manufacture of textile fabrics, ship building, steel works and tubing mills, are located principally along the river front where wharfage is available and also where railroad freight facilities are afforded. The Delaware River at this point is over a mile wide, the waters are tidal, the normal stage being about 6 ft., and the velocity during the strength of the ebb and flow is very strong. The main channel follows the shore along Chester City. At the foot of Fulton Street along the river the New Chester Water Company's pumping station is located. Chester Creek empties into the river about 1500 ft. up stream from the pumping station and Ridley Creek is about one mile still further up stream. There are large public sewers emptying into both of these creeks and into the river and in consequence the waters are polluted and entirely unsuitable to use as a source of public water supply in the raw state. The Water Company's intake is at such a place in the river that the sewage from the city sewers may be taken by the tide back and forth over said intake. Seven years ago the courts were appealed to in proceeding to compel the water company to furnish pure water and this appeal resulted in the installation of the filter plant and the turning on of filtered water for the first time in 1903. No effort has been made by the city to minimize the gross pollution of the river at this point so that now more sewage than ever of a local origin is discharged into the water supply of Chester City.

Briefly the physical system comprises a pumping station force main to a hill in the township back of the city, a subsidence basin, filter plant and filtered water reservoir there and a gravity supply and distribution system. Sulphate of alumina is used at the filtration plant as a coagulant and chloride of lime is used as a germicide.

The First Conference.

The first conference was held at Chester April 28, 1915. There was present representing the petitioners:

A. A. Cochran, City Solicitor.
 John MacDonough, Attorney.
 A. E. Howell, Attorney.
 J. C. Taylor, Attorney.

Representing the respondent company:

A. M. MacCallum, Secretary and General Manager.
 H. S. Hoffer, Treasurer.
 J. B. Lippincott, Director.
 W. B. Harvey, Attorney.
 Joseph T. Bunting, Counsel.

Mr. Harvey opened the conference by the following statement:

"The South Ward water works, a quasi municipal enterprise, was purchased by the New Chester Water Company under an agreement of 1887, which provided, among other things, for flat water rates and the use of meters under certain conditions. At that time there was a two dollar minimum meter rate which in 1911, was fixed at one dollar, with the right to use 3,333 gallons per month. In 1913, the question of metering all the services was taken up by the company and in order to save a large amount of waste of water, it was decided to meter all connections and rules were adopted compelling the sale of all water by meter and providing for the minimum charge of one dollar per month for the use of water up to 3,333 gallons per month. Beyond that quantity the charge of 50 cents per thousand gallons is to be made which is the old charge for meter service for the small consumer.

In 1914, the company notified about 600 of its patrons under the rules and regulations that meters will be put in at the company's expense within 30 days. The company started to put in these meters but was stopped by an injunction, still in force, pending the decision of the Public Service Commission as to the right and justice of an alleged increase in rates from 50 cents per month to one dollar per month. The small consumer on the flat rate basis now pays \$6.00 a year, or 50 cents per month for all the water he may use. The putting of this small consumer on a meter service basis with a minimum charge of one dollar per month, constitutes the increase as alleged by the petitioner to be without authority in law or in equity.

The said agreement of 1887, as to rates, is indefinite as to time and hence illegal, as determined by the Supreme Court—Judge Elkins' opinion in the Bellevue vs. Ohio Valley Water Company case. The company contends, so Mr. Harvey stated, that the Public Service Commission has the power to revise the rates, the 1887 agreement to the contrary notwithstanding, and the conference is for the purpose of trying to reach an agreement on the minimum charge of one dollar per month.

Continuing, Mr. Harvey stated that the Public Service Commission had granted three hearings in the case and taken testimony. At the last hearing the question of the landlord and tenant rules of the company was heard. The company submitted an amendment which was not acceptable to the city and it was finally agreed that Mr. Snow should meet with the parties and to take up the question of the rules and of the one dollar minimum charge."

Mr. Cochran had made written statements for the conference. They were as follows:

RATES.

"1. The minimum meter rate of one dollar per month or twelve dollars per year.

RULES.

2. The OWNER or OWNERS of premises supposed to be connected for water supply service, or his or their agents, must sign the application.

3. In all cases of flat rate water supply service the company reserves the right to install a meter or meters and change the service to a metered basis at any time upon thirty days notice to the OWNER and upon the giving of such notice the OWNER shall, before the expiration of the time thereof, make formal written application to the company upon a blank form provided for that purpose for such meter service, and failure to make said formal application shall authorize the company, at its option, to cancel the existing flat rate water service contract and to discontinue its service without further notice.

4. OWNER will be held fully responsible and liable by and to the company for all that is done or omitted, injuriously affecting the company's property or service on, in, or about their respective premises by any agent or tenant, or other persons not in the employ of the company who may gain access thereto.

5. The TENANT in or upon any premises of any OWNER shall, at all times and for all purposes, connected with or arising from the company's water supply service to and for such premises, except the making of the original application or contract be taken and construed to be the properly constituted agent or OWNER.

6. Each and every addition, modification, alteration or amendment to and any of the rules of the company shall be and become binding upon the expiration of thirty days notice thereof in writing to each and every OWNER affected thereby, unless and except any such addition, modification or amendment as by these rules provided and to be and become effective and binding on every such OWNER, or any one or more thereof."

Discussion of Rules.

It was decided by the conference to take up the discussion of the rules, and the company by Mr. Harvey offered the following:

1. The water company will furnish water by meter only to its consumers, except for public fire protection.

2. At the request in writing of any landlord the water company will furnish water to any tenant, the latter to pay for the water in accordance with the rules and regulations of the water company and make the deposit therein required.

3. Each and every tenant consumer of water shall make a deposit with the water company as security to cover the payment of bills for water consumed before water is turned on. Said deposit shall be based on the size of meters as follows:

$\frac{5}{8}$ inch meter,	\$5.00
$\frac{3}{4}$ inch meter,	10.00
1 inch meter,	12.50
$1\frac{1}{2}$ inch meter,	15.00
2 inch meter,	17.50
3 inch meter,	20.00
4 inch meter,	22.50
6 inch meter,	25.00
8 inch meter,	30.00

4. Meters to be read monthly.

5. The landlord to give notice to the water company of any change of tenant so that meters may be read and removed, and upon failure to do so, to be responsible for all meter rent subsequently accruing until a new contract is entered into with the new tenant at the request of the landlord.

6. In the event of the water being turned off for non-payment of water rent, the company will not turn the water on again until the arrears of water rent are paid.

7. No water to be furnished to any consumer while indebted to the water company for unpaid water rent.

In explanation of these rules, Mr. Harvey said:—

That Rule 1 provides that all connections shall be metered.

That Rule II makes the landlord the applicant and the responsible party. If the tenant moves out, the company which has furnished the water does not lose. It looks to the landlord. Now if the tenant wants water, the company can be prevented by the owner from trespassing on the property to install meters. The company is arrested for trespassing. It is an aldermen's case involving for costs and fine about \$5.30 and the company has no redress. But if as the rule provides the landlord is the applicant, the company will be protected. The company wants the landlord to say: "Give water to the tenant." Then the landlord is a party to the contract and cannot claim damages to property or for trespass. Besides, tenants move out, do not protect meter when they vacate property; it freezes, and the consequent damage and loss is the company's. If the landlord is made responsible he will protect the meter and save himself and thus the company will be protected.

Mr. Nowell thought that the rules ought to provide that the tenant be the applicant, with the consent of the landlord. The landlord signifying his consent to the application would be construed to be his consent to the entering on to the property and the making of the meter connection by the company, thus the landlord would be bound.

Continuing, Mr. Harvey said:—

That Rule 3 requires a deposit of \$5.00 for all $\frac{5}{8}$ " meters. This will include 98% of all the consumers.

That Rule 4 requires the meter to be read each month instead of quarterly, as the city contends should be the case.

That Rule 5 affords the company necessary protection. Suppose a tenant moved into a dwelling and stayed two weeks only and then moved away and then a new tenant came in. The landlord gets his rent in advance so he is protected. The water company gets its pay after the service is rendered but the tenant has gone and the company knows nothing about it. When the new tenant's bill is made out it is found to be too large. The new tenant will not pay the large bill so the company suffers loss. The landlord should be held responsible for the water rent in this and all cases. To this proposition the city objects.

That Rule 6 provides that the company will turn off the water if there is no payment and the company will refuse to turn on the water again until the money due is paid. The tenant who has gone with an unpaid bill cannot be found so the company must hold the landlord responsible for the arrears.

That Rule 7 means no water, if no pay.

Taking up the discussion of these suggested rules offered by the Company as a matter of compromise, Mr. Cochran said:—

A compulsory metering of all connections—including the question of charges for meter service—may be all right but the present schedule provides for flat rates and meter rates. We must remember that it will take many months to meter all connections and that meantime consumers will be on flat rates, gradually diminishing in numbers until all are metered. We must look after these flat rate people as well as the metered people and as long as there are flat rate consumers, the old schedule of flat rates must remain in force under the agreement.

About meters—originally the company was opposed to meters. If it put them in the consumer had to pay for the meter. This discouraged meter use. The company after a while said it would pay for the meter put in. Now, in 1914, the company changed front and started to compel every one to have a meter at the expense of the company alleging the reason to be prevention of waste of water, but the strongest reason, we believe, was to increase the company revenues.

Mr. MacCallum replied:—

That in 1888 the company reserved the right to meter any consumer. The minimum charge per month then was \$2.00. In 1890, the company reduced this minimum to 50 cents and this minimum was in use until 1911, when it was raised by the company to \$1.00, which minimum is the same in the present schedule. The flat rate should stand as in this schedule which corresponds with the original tri-partite agreement. Furthermore, the \$1.00 minimum meter rate should stand. It is not an increase in meter rates.

Mr. McDonough took up the proposed Rules Nos. 2 and 3. He said:—

“The landlord ought not to be held responsible in the company's rules, for the debts of the tenant. A man owns a property on the flat rate service. The tenant has all the water he wants. He may waste it so far as the owner may know. He may be careless and let the pipes freeze. He may do any one of many things over which the owner of the property has no control. It is unjust to the owner to make him responsible for the negligent acts of the tenant.

Make the tenant responsible and he will be careful. Let the tenant be free of all responsibility and he will cease to care less what happens. The company is protected and the owner is protected, if the tenant is made responsible. No body loses this way.

The Public Service Commission can make rules and regulations and compel

the company to adopt them which will afford protection alike to the company and the owner. This is what I want to see done.

Suppose the tenant skips out in the winter and leaves the house empty with no fire to prevent the freezing of the pipes and the meter and the owner knows nothing about it for a few days during which the harm is done, the pipes burst and large quantities of water are wasted. Why should the landlord be held responsible. If the owner will not pay the bill for this loss of water, the company shuts the water off. Now along comes the next tenant. He wants water and should have it and be responsible for it. The company should be compelled to render the service to the newcomer and the company ought to have the right to enter the property and put the meter in; but not at the responsibility of the owner to pay for the meter. It is all right for the company to be protected and so a money deposit of small amount is proper; but it would not be proper to make the landlord pay the deposit. Put the responsibility on the tenant.

The water company should get all and no more than other utilities get in similar matters. The gas company and the electric light company do not require the owner or landlord to be responsible, no more should the water company. Put in a meter at the request of the tenant and have the contract between the tenant and the company.

Mr. Harvey discussing Rules 4 and 5, said:—

Suppose a tenant gets the water by contract with the company and is held responsible for the pay and the company reads the meter quarterly as the city requests. Suppose that at the end of one month the tenant skips out without paying. That argues for a money deposit made by the tenant to cover such a circumstance.

Further, suppose a landlord puts in a new tenant. The new tenant cannot be made to pay for the previous month's water bill, and there is all manner of arguments possible as to what the new tenant's bill should be at the end of the quarter. It is best for the company, therefore, to read every month.

Now, as to a notice of vacancy of property: We ought to agree that the landlord should help protect the company, by giving notice to the company of any change in tenant of which he has knowledge. This was agreed to.

Mr. Cochran took up the discussion of Rules 3 and 6. He said:—

The deposit of \$5.00 is too much. In the first place in Chester, the tenants do not move out of the city or suburbs. They simply move from one neighborhood to another. The class of employment keeps him in the water company's territory. So in this fact the company is protected. The loss from tenants moving to a distant city will be very small because most of the men who do move away are honest citizens, accustomed to paying their bills. It is best to take as a standard of deposit an amount not much greater than the average charge to household consumers covered by two months bills. On the average the five-eighth inch meter user,—98% of the consumers—will not use over 1,000 gallons per month. This was tested out by the city. 284 meters were read in February, 1915, all of them were on \$6.00 per year houses under flat rate schedule.

The average meter reading for the month was 979 gallons. This is 12,000 gallons per year, and at 30 cents per thousand gallons (the 1887 meter rate for this class of consumer) it would be equal to \$3.60 per year. So a deposit of \$5.00 is too much to protect a company from loss by the tenant moving away, when bills are rendered monthly.

Mr. Snow made certain suggestions about proper rules applicable to the situation. He told the conferees that there would be a meeting of the representatives of the Pennsylvania Water Works Association at Hotel Adelphia, Philadelphia, the next day, and invited them to come to Philadelphia and hear the discussion. He said the same landlord and tenant and other problems of much concern to the Chester people would be up for general discussion. The invitation was accepted.

Discussion of Rates.

Mr. MacCallum: The company has a right under the tri partite agreement to meter everybody. The company has appeared before the Commission and filed a complete statement of its inventories, which are evidence in the case. We have shown that we are making barely 5% on our bonds. We have never paid dividends on stock and we have no reserve or depreciation funds.

We must have more revenue with which to continue the company's business. Meters are proposed to afford an increase and to stop waste in consumption of water. The charge of \$1.00 minimum meter rate on the basis of water consumed at present will not be an increase of the meter rates in the tri partite agreement. If so, we will go before the Commission, have a review of the entire rate question and ask for an entire new schedule to enable use to get a fair rate on our investment.

Mr. McDonough: Chairman Pennypacker of the Commission said at the February 2nd hearing (reading from the testimony) as follows:—

"Chairman Pennypacker: The first question is whether or not you want to take advantage of the opportunity that has been presented to you by the other side, of looking into their books and such inventories as they may present to you to get information on that subject. Do you or do you not?"

"Mr. Cochran: Of course, I would have to answer that by saying that we would prefer to thresh that matter out here in this hearing. Of course, if your ruling is adverse to us, then we would like to have the opportunity of conferring and making up our minds as to the expense. I would not want to answer that myself, I have a number of colleagues here, but we would like to, if we are within our province, have the privilege of asking whether it is not up to the other side to present their case before this Commission, before we either have to answer or make an examination. An examination of their books and all their properties would be a somewhat expensive undertaking, and while there is a municipality in this controversy, there are a lot of small consumers and we have not very much money to spend."

"Chairman Pennypacker: That being your attitude, I think I may say that the Commission does not want to interfere in any way with the presentation of the case as counsel may advise that it is well that it should be presented, but individually my own thought is, so far as I understand it, that this is not a case which would require the Commission to go into an examination of the property and the inventory and an ascertainment of the value and an ascertainment of the general returns to the company, which would mean an involved and lengthy examination. The real question as you have presented it seems to me a question as to whether the agreement which was made some thirty years ago is an agreement which binds the water company, notwithstanding the Act of

1913, and that is a legal question that apparently is the main and substantial question that you want to raise in this case."

"*Mr. Cochran*: That certainly is a very vital question."

"*Chairman Pennypacker*: There is a further one, and that is a question as to the reasonableness of this \$12.00 a year minimum meter rate. That I do not think you can determine by an examination of the valuation of the property, because that means a general return, and that involves all the other rates, and therefore I think the reasonableness of that minimum charge, if it be a question, it is justified on the ground that the company is entitled to make a service charge. We have some little information by which we can make a determination of that question, but very little of the evidence has been presented, and possibly both of you would want to offer testimony upon that subject, I mean upon that narrow point as to whether or not, in addition to the argument upon the agreement, as to whether or not this \$12.00 a year minimum meter charge is a reasonable charge; but as I view it—of course you have to determine how you will present your case yourself—I do not think the Commission wants in this particular case to go into that involved inquiry. The point is a narrow one."

"*Mr. Cochran*: That is our thought exactly."

"*Chairman Pennypacker*: I thing, Mr. Bunting, that it is incumbent on the company to give us such evidence as they have or care to present on that question, as to whether or not this \$12.00 minimum rate is a reasonable charge."

So the Commission does not want to go into the matter of inventory and the whole rate proposition. The only question is the agreement of 1887 and the new \$12.00 per year or \$1.00 per month minimum meter charge. This being the rule of the Commission, the petitioners have not taken up the valuation of the property, although the company did put in evidence its inventory and appraisal.

Mr. Bunting: The Commission will take up the inventory and appraisal matter if we desire it. I will read further from the testimony in the case to show that this Commission does not purpose to say how we shall conduct our case.

"*Chairman Pennypacker*: (Referring to the company) You very generously offered to let the other side look at your books and papers, but they do not seem to care to do it. So far as I am concerned, individually, I do not think it is necessary that you should have that burden of proving the value of your property and returns and what not. If you give evidence to show that this \$12.00 a year is a reasonable charge, then we will have that question before us, but I think that is a comparatively narrow question, is it not?"

"*Mr. Bunting*: It may be called a comparatively narrow question, but the evidence which is required to support it depends upon the earning power of the company and also upon the value of its plant. We cannot get away from investigation into the value of the plant and its earning capacity, that is to say any justification of our rate must do it."

"*Chairman Pennypacker*: I was in hopes you would see your way to escape that this involved an extended inquiry, because it is an extended inquiry."

“Mr. Bunting: That is unfortunately so. We regret it as much as anybody, that that is the evidence upon which we rely to support our rate.”

“Chairman Pennypacker: It is not for me to suggest, but it seems to me on the question of what would be a reasonable service charge, that that must be a pretty general question, I mean that what would be a reasonable service charge is a matter of experience upon the part of water companies.”

“Mr. Bunting: Under the authorities we are entitled to a certain rate of return and for dividend.”

“Chairman Pennypacker: You are entitled to a certain rate of return, but you see your return will depend not only upon this question, which is a very small part of it, but upon all of your returns, upon the whole of your rates, and they are not disputed. There is no contention here that your rates, that your general rates, are too high. They have not lodged that at all, and your returns will depend upon them, not upon this alone.”

“Mr. Bunting: I think it does depend upon them, that is to say the value of the plant and our present earnings, on the \$12.00 basis would show that we are not earning enough now, not earning what we should.”

“Chairman Pennypacker: It is not our thought at all to close you out from any evidence you want to present. I thought I would give an indication as to a view upon the subject, but if you ought to present all the matters of this water company and all of their income and all of their property.

“Mr. Bunting: In order to justify our position entirely, in order to show that so far as the tri partite agreement is concerned, that agreement of 1887 has not been varied from by the company. The company does not consider that it is legally binding either upon the city of Chester or upon it for the reason that it was entered into for an indetermined time.”

“Chairman Pennypacker: Was there any time fixed in that agreement?

“Mr. Bunting: No. Under the recent decision in the case of the borough of Belleview and the Belleview Water Company, by Justice Elkin, it was held that an agreement for an indetermined time is not binding on either party; but, however, we claim not to have varied from that.”

“Chairman Pennypacker: That is the legal question?

“Mr. Bunting: Yes.”

“Chairman Pennypacker: That seems to be mainly upon what they are standing on the other side. They contend you are bound by that agreement and that agreement prevents you from putting in this meter minimum charge. That will be their contention, and as I gathered, it was the main contention that they had.”

“Mr. Bunting: I contend that having made the offer which we have, for them to investigate our property and put a valuation on it—”

“Chairman Pennypacker: And if it be essential to go into an inquiry of this corporation, into its plant, of course the Commission are here to do it but that means a long and involved inquiry, and if it is not essential, then it saves a great deal of time and effort and trouble on your part as well not to do it. I think that the Commission generally considering a question as to a commodity rate, have regarded that as only one part of the great business, and have looked at the commodity rate without considering all the business and all the investments of a corporation, which is a very large and extended matter, and this looks to me a little like it. You have but one branch of your return that you are considering, and to me it looked a little as though that was a matter that could be determined on other lines, but may be not.”

“Mr. Bunting: But suppose that even it should be confirmed. Is there any reason why the other party should not proceed in the regular way of proof?

“Chairman Pennypacker: About that question the inclination of my own mind is against you, that you had a minimum rate and now you have a minimum meter rate, and that is double the amount. That does seem to be an increase. You would say that is a service rate, but your minimum rate before included your service and your supply of water, both.”

“Mr. Bunting: But that rate has not been changed since the Public Service Commission Law came into effect. From the time that the Public Service Commission Law came into effect, we had that minimum rate and we posted all the rates here, posted them twice, and no change is shown since that time.”

“Chairman Pennypacker: Practically it does not seem to be very important as to whether you go on now or go on later on that line of inquiry, if you are going to make it, and I think you had better go ahead, if it is your thought that that is involved in it. Having had a certain suggestion or intimation from the Commission, possibly you would like to take a little time and think about it, or have you made up your mind?”

“Mr. Bunting: I am prepared to ask of Mr. MacCallum the evidence which he has collected as to the value of this service, as part of our minimum.”

Mr. Snow. Mr. Snow decided that all he could discuss with the conferees was the question of rules and regulations and the question of the minimum meter rate. The question of the entire rate schedule, if pursued, would have to be heard before the entire Commission. This was agreed to.

Mr. MacCallum. The 1887 flat rate under the tri partite agreement are discriminatory and preferential. The minimum meter charge of \$12.00 now proposed, is substantially a ready-to-serve charge on the public,—everybody being treated alike. If this could be brought about, the large consumer and the small consumer will be alike. The large consumer would pay for the first ten thousand gallons a fixed price per gallon; next, between 10,000 and 20,000 gallons there would be a step-down in price and so on. All would be treated alike under the measurements of the water used by meter.

It is claimed by the city that the involved service charge in minimum meter rates proposed is too high. This is not so. The water company wants 7% return on its investment and 1% for depreciation.

The company has 3,600 dwellings on the flat rate of \$6.00 per year.

This nets,	\$21,600.00
Then the company gets from large consumers, approximately per year,	54,000.00
<hr/>	
Total income now on flat rates,	\$75,600.00
Total income now on meter rates, large consumers, approximately,	72,000.00
<hr/>	
	\$147,600.00
Add increase for city, etc., approximately,	15,000.00
<hr/>	
Grand total income now,	\$162,600.00

More income must be had. This increase must come from the consumers. If the proposed service charge (included in the \$12.00 minimum meter rate) is too high, the company will reduce it provided we get 7% plus 1% plus operating expenses elsewhere on a fair and equitable basis of the valuation of our property that will stand in law.

The company is entitled to this. Principle upon which we stand has been declared time and again in the decisions of the Public Service Commission and the Courts of various states.

If the service charge of \$8.00 is too high let the company reduce it and let the city pay it. Our whole attitude is based on the proposition that we must have sufficient money for operating expenses, interest and depreciation on a fair value of the property—not on the \$1,800,000 face value of the bonds. This fair valuation was placed at \$2,300,000.

The company is incorporated and has charter obligations and public service functions to perform. The revenues under the flat rate schedule of 1887 are insufficient for this performance and so, instead of revising the flat rates, we purpose to put everybody on the meter basis which is fair. All will then pay the same price for water used and this will obviate discrimination and preferential charges.

If after all connections are metered we find that the \$8.00 service charge is not giving sufficient revenue, we purpose to go to the Commission for more revenue. The city has tried to stop the company from getting an increase. The city took us before the Commission. We are the Respondents and we will have to fight for our very life. The city cannot stop us in our right to be heard before the Commission and the Courts. Justice is all we are after and we have the facts to show. We have already presented them to the Commission in part—enough to justify the \$8.00 service charge—so we think.

Mr. Cochran: The company's testimony shows about \$7.40 as a service charge. Mr. Hazen has testified that \$4.00 is amply sufficient for such a charge based on meter readings. The overhead charge figured by the company to get the total service charge is too high. It should be reduced.

Mr. MacCallum. The service charge is calculated from the estimated total cost of metering everybody. To install meters, maintain and operate and replace them amounts to \$5.11 plus overheads equalling a total of \$7.40. We

have to assume in this estimate that the whole town is metered. We figure as follows:

The bonds have a face value of \$1,800,000, we have a fixed charge on this amount of 5% interest which we have to meet. Then we pumped 1,240,000,000 gallons per year. We know what that costs. We say that a $\frac{3}{4}$ " meter has a discharging capacity of 15 gallons per minute. On this basis and on the basis of the cost to operate during the year 1914, the costs of operation will be \$1.33 per meter if everybody is metered. Then the ready to serve charge as figured amounts to \$6.57 or a total of \$7.90 say \$8.00 for the total ready to serve charge on the basis of everybody being metered.

We also estimate that 1-6 of the cost to the company should be a fair proportion for the city and public to pay for fire protection service, etc.

Now to restate it, we assume that all connections are metered. The valuation of our property is \$2,300,000. We want 7% on this and 1% additional for depreciation. In this way we arrive at the amount of revenue annually that is to be obtained. Then we divide the annual revenue sought into 1-6 part for fire protection and public use and 5-6 parts for all other service.

Then 5-6 parts are then divided as follows:

Consumers charge (total units $\frac{3}{4}$ " meters at 15 gallons capacity per minute),	\$1.33
Ready to serve charge,	11.01
	<hr/>
	\$12.34

The city to pay \$124 per year for fire hydrant.

After a lengthy discussion of the subject in which everybody took part, Mr. MacCallum continuing stated if the company were to get a service charge of \$6.00 from the poor man (the small consumer) and give 10,000 gallons of water per year, then the company would compel all other service to pay \$6.00 service charge plus a charge for all the water used as metered by the meter. This would give an increase but not enough unless the rates were raised.

Mr. Taylor: After further discussion by all present, including Mr. Snow's suggestions, Mr. Taylor stated why not figure on the basis of a sliding scale of minimum meter charges for $\frac{3}{4}$ " meter users as follows:

- \$6 per annum or 50c per month using 1500 gallons per month.
- \$9 per annum or 75c per month using 1500 to 2500 gallons per month.
- \$12 per annum or \$1 per month using 2500 to 3300 gallons per month.

This would give the company an increase and at the same time keep the small consumers minimum where it now is on the flat rate basis.

Mr. McCallum: There are 300,000,000 gallons or more water wasted every year in Chester. It costs 8 cents per 1000 gallons to pump, filter and distribute this water. Save this water and the company will save \$25,000 annually which it could realize on by sale of the water as the demands increase, while now with no meters it can get no return from this water which goes to waste.

It costs \$16,000 per year to pump 1,249,000,000 gallons, one-fourth of this is wasted water. One-fourth of this wasted water or one-fourth of \$16,000 equalling \$4,000 is the cost of pumping the wasted water; but some part of this cost goes for the engineers, firemen, etc., which is a constant fixed price

but about \$2,500 of this \$4,000 goes for coal. This \$2,500 represents actual cash out-lay which will be obviated if the waste is stopped. When meters are put in if the consumer wastes the water it will be metered and the principal will pay for it.

Mr. Cochran: Mr. Hazen testified, that upon the basis that a minimum meter charge of \$1.00 per month was fair for the use of 3,333 gallons or less, then there ought in justice to be a stepping-down of such minimum charges for smaller consumption of water and he suggested the following proportional reduction:

Minimum meter Charge per month.	Gallons of water Used per month.
50c.,	800 gallons or less.
60c.,	800 to 1,300 gallons.
70c.,	1,300 to 1,800 gallons.
80c.,	1,800 to 2,300 gallons.
90c.,	2,300 to 2,800 gallons.
\$1,	2,800 to 3,333 gallons.

Mr. Cochran: Mr. Cochran further stated that about 36% of the consumers pay \$6.00 per year under the flat rate schedule. Most of these consumers do not use over 1,000 gallons per month. He was not in favor of keeping the meter rates for this class of consumers down to this cost or a minimum of \$6.00 per year. Above this amount of consumption is the place to apply the increases. He wanted to be fair to the company and he wished the company to be fair with the people.

Mr. Snow: Mr. Snow suggested that the company's plan was to justify a service charge as a minimum meter charge instead of calling it by its right name, a service charge. The minimum has to be figured the same way as a service charge is figured and the company then calls this result a minimum meter charge because the tri partite agreement of 1887 makes this way possible, there being no provision in said agreement for a ready to serve charge.

Assuming that the right thing all around is to meter the water and charge a uniform price for it on all users alike, and that a service charge or ready to serve charge is also the straightest way, the easiest to properly ascertain and to make understood by the public, why not settle this case on the following basis:

The city to withdraw its opposition to all connections being metered;

The company to go ahead and meter everything;

The company meantime to put into effect a minimum of \$6.00 instead of \$12.00 per year for $\frac{5}{8}$ " meter connections, using 1,000 gallons or less; some substantial increase for the class using more than 1,000 gallons per month, and the old price to stand as to flat rates and meter rates in excess of quantities allowed on the minimum scale.

Then when the company has installed the meter which will take, say, 18 months, it will be time enough to decide on the question of adequate revenues and to determine definitely from the facts ascertained as to the cost of installing meters and their operation and maintenance, a proper service charge if one is to be made at all. At that time, the company will be in possession of data and facts to fully justify any necessary increase in revenue and satisfy the citizens of the city about it, or to properly bring the whole subject before the Public Service Commission for determination.

The representatives of the citizens agreed to this proposition and the com-

pany's representatives said they would bring this basis of settlement up for consideration to the directors of the company and let the results be known to Mr. Snow, so that a final conference could be had at an early date.

Mr. MacCallum: The water company has proceeded regularly and in conformity with the Public Service Company Law. It prepared a new schedule, posted it and filed a copy with the Commission. The minimum meter rate of \$12.00 is no different under this new schedule than in the old one. The \$12.00 minimum rate was in the 1911 schedule. We have a property worth \$2,300,000. The metering of everybody is calculated to give us \$70,000 gross additional without any increase in rates. This is all legal. Now you ask us to adopt half the \$12.00 rate for $\frac{5}{8}$ " meter service. Such a schedule will not give us sufficient additional revenue. Nevertheless we will consider the same.

Mr. Hoffer: I would rather have you take our figure and if at the end of the first year we find we are getting too much money we will reduce the rates. The company would much prefer, however, to take up the whole question of rates at this time with the Public Service Commission.

Mr. Cochran: The city objects to the Public Service Commission going into the whole rate question. We do not admit that there is any question raised except to the interpretation of the 1887 contract. If the Commission decided differently we shall want the right to look into the valuation. The city will not raise the whole rate question.

Mr. Taylor: What we now propose as a settlement will give the company the 20% increase in revenues and permit the company to meter everybody and save all the waste water. My idea is that the following minimum charges should be:

Minimum Meter Rate.	Consumption per Month.
\$6.00 per year,	1000 gallons or less.
\$9.00 per year,	1000 to 2000 gallons.
\$12.00 per year,	2000 to 3333 gallons.

50c the regular price for 1000 gallons for water used by meter in excess of these quantities on the smaller consumption and the other schedule rates to stand.

Tentative Agreement as to Rules.

The following rules were drafted to be considered between now and the next conference:

It is the purpose of the water company to furnish water by meter only to its consumers, except for public fire protection and the following rules are based upon meter service:

a—The water company will furnish water to any tenant, with the consent in writing of the landlord, or his duly authorized agent and agreement to comply with Rule (d) herein. The tenant should pay for the water in accordance with the rules, rates and regulations of the water company and make the deposit therein required.

b—The water company may require each and every tenant consumer of water to make a deposit as security to cover the payment of bills for water consumed and damage to meter occasioned by negligence of consumer, before water is turned on. Interest shall be paid on deposits at the rate of 4% per annum.

Said deposits shall be based on size of the meters not exceeding as follows:

$\frac{5}{8}$ " meter,	\$3.00
$\frac{3}{4}$ " meter,	10.00
1 " meter,	12.50
1 $\frac{1}{2}$ " meter,	15.00
2 " meter,	17.50
3 " meter,	20.00
4 " meter,	22.50
6 " meter,	25.00
8 " meter,	30.00

c—Meters to be read monthly and bills presented monthly.

d—The landlord or his agent shall give notice to the water company of any change of tenant of which he has knowledge so that meters may be read and recorded, and upon failure to do so, to be responsible for all water rent subsequently accruing until a new contract is entered into with the new tenant.

e—No water to be furnished to any consumer while indebted to the water company for unpaid water rent.

The Second Conference.

The second conference was opened at Chester City, Monday, May 24th, 1915. Same appearances as before with the exception of Mr. Lippincott who was absent. Mr. Snow presided.

Mr. Harvey: Acting on Mr. Snow's suggestions, Messrs. Cochran, Howell, McDonough and Taylor met with the water company on May 5th, and reported that they, representing the petitioners in this case, would be willing to accept one of two propositions for a meter minimum as follows:

1st:

- 1,000 gals. or less at \$0.50 per month minimum charge.
- 1,001 to 2,000 gals. at \$0.75 per month minimum charge.
- 2,001 to 3,333 gals. at \$1.00 per month minimum charge.

The old meter rates in the tri partite agreement to stand, or they would be willing to accept:

2nd:

- 1,000 gals. or less at \$0.50 per month minimum charge.
- 1,001 to 3,333 gals. at \$1.00 per month minimum charge.

The old meter rates in the tri partite agreement to stand. The water company will accept the proposition of furnishing:

- 1,000 gals. or less at \$0.50 per month.
- 1,001 to 3,333 gals. at \$1.00 per month.

And the rates for meters as written in the tri partite agreement to stand unless they are changed by the Commission, all with the following understanding:

1—That Mr. Cochran, Mr. Howell, Mr. McDonough and Mr. Taylor, with Mr. Bunting, Mr. Harvey and the officers of the company appear before the Public Service Commission or its representative and have thoroughly understood all of these questions; the same to be put in writing and settled.

2—The city, through its duly authorized legal agent and the citizens, who are now contesting in the local courts the right of the company to meter, shall remove all objections and withdraw all suits pending.

3—The city will allow the company to install meter boxes outside whenever it is necessary to protect the property of the company; the citizens and authorities outside of the city of Chester to concur in the same.

4—The objections to the rules as filed being accurately settled; all suggestions and changes agreed to in writing shall be incorporated in any new rules and the Commission's authoritative confirmation shall make them binding in connection with the minimums as above set forth.

5—It is to be definitely understood and mutually agreed by all parties in interest that the proceedings now before the Commission shall remain open and that the company is to have a year's trial under the new minimums and if it does not give the proper return upon its investment, that then proceedings will be re-opened and the matters taken up by the Commission and properly settled by them.

The company now awaits the answer to this proposition which is before the conference.

Mr. Cochran: Mr. Snow thinks that this proposition to keep the questions open for one year will not be satisfactory to the Commission. I, myself, certainly object on behalf of the city to keeping the matter open.

Mr. Bunting: We are willing to settle the case now provided the terms of this settlement shall not prejudice us as to our future rights and conduct.

Mr. Snow: I will recommend that the order of the Commission shall state that it is understood that the order is issued without prejudice to either party to subsequently raise the question as to the adequacy or inadequacy of the rates.

Mr. Cochran: We will agree to the main proposition and to the second provisional stipulation of the company.

With respect to the third stipulation, "The city will allow the company to install meter boxes outside whenever it is necessary to protect the property of the company, the citizens and authorities outside of the city of Chester to concur with the same." I and my colleagues object because we are in no position to bind or attempt to bind citizens and municipalities outside of Chester. This condition ought not to be asked for by the company and the company should waive it.

The following is a copy of the ordinance which the city of Chester purposes to ordain granting permission to the water company to put meter boxes in the sidewalks of the streets of the city provided the Commission ratifies the conclusions of this conference and issues an order accordingly.

(Mr. Cochran then handed Mr. Snow a copy of the proposed ordinance. It may be found in the Appendix to this report.)

With respect to the fourth stipulation, it is understood by us that Mr. Snow will recommend to the Commission for this order rules as tentatively agreed upon at the last conference and the company shall make all necessary changes in its other rules in conformity therewith.

Agreements.

The agreement as to rules, minimum meter rates and the meter schedule as hereinbefore described, was reached with the following understanding:

1—That Mr. Cochran, Mr. Howell, Mr. McDonough and Mr. Taylor, with Mr. Bunting, Mr. Harvey and the officers of the company, having met together with Mr. Snow, and thoroughly understanding and agreeing to all of these matters, the same shall be submitted to the Public Service Commission for its finding and order. (Agreed to.)

2—That the agreement as to the minimum meter rate is predicated upon the basis that the city, through its duly authorized legal agent and the citizens, who are now contesting in the local courts the right of the company to meter, shall remove all objections and withdraw all suits pending relevant thereto. (Agreed to.)

3—The city will allow the company to install meter boxes outside wherever it is necessary to protect the property of the company: The citizens and authorities outside of the city of Chester to concur in the same. (Not agreed to outside of city.)

4—The objections to the rules, as filed, being accurately settled; all suggestions and changes agreed to shall be incorporated in any new rules, and the Commission's authoritative confirmation shall make them binding in connection with the minimums as above set out. (Agreed to.)

5—It is definitely understood, while the proceedings before the Commission in this case will be terminated by this agreement, that the company will under the new minimums provided, try out the rates and the order of the Commission is to issue without prejudice to either party to subsequently raise the question as to adequacy or inadequacy of the rates. (Agreed to.)

General Discussion.

What a Minimum Meter Service Charge Should Be. The utility is primarily interested in the total return of the rate schedule, and secondarily interested as to the degree of fairness of the rate schedule among different classes of consumers.

The distribution of the burden among the class of consumers is more a matter of economy and good public policy. Water rates seem to be quite generally a matter of agreement as to what the company can get, scientific cost analysis and apportionment.

The average citizen can understand the justice as the unit of measure for service, of the cubic foot of water and gas, the telephone instrument and the kilowatt hour standard. These elements are only one of three which enter into the cost of service. They are:

- 1—Consumers Cost.
- 2—Readiness to Serve Cost.
- 3—Pumpage Cost.

It may be predicated on through that no water rate is reasonable, or fair or just unless it takes into account a measurement of the service,—the meter.

The "sliding rate" or "step rate" seems to the small consumer who pays the highest rate, to be only another device for extorting money from those whose meagre earnings confine them to the mere necessities of life. The fair minded

man wants only a square deal. He wants eliminated unjust discrimination and he wants candid dealings and civil treatment from the utility. The methods of stating rates are:

- 1—The unmetered *Flat* rate.
- 2—The metered *Straight* or *Flat* rate.
- 3—The graduated rates (higher for the small consumer.)
(lower for the large consumer.)

(a) Rate based upon total consumption for given period (say one month.)

(b) Rate is a certain amount for first unit quantity of consumption during that period and a descending amount for each additional unit quantity.

(c) Rate is a "fixed charge" plus a "straight meter rate."

The sliding scale, unless very carefully adjusted to the demands of the different classes of consumers, will work out very unfair discrimination between consumers.

It seems best to adopt

"Fixed charge" or "Flat rate" covering { Customers cost
plus
Investment cost

To this add a "Flat meter rate" based upon production cost. The following is an example of how this will work out:

TABULATION SHOWING VARIATION IN COST DUE TO VARIATION IN USE ON DEMAND OR VARIATION IN QUANTITY OF WATER CONSUMED IN ONE MONTH.

Gallons Used in One Month.	Customers cost per month.	Investment cost per month.	Pumpage cost. Total.	Total cost per month.	Customers rate per 1000 gallons.
00,	\$0.15	\$0.83	\$0.00	\$0.98	\$0.00
500, .....	.15	.83	.01	.99	1.98
1,000, .....	.15	.83	.02	1.00	1.00
3,000, .....	.15	.83	.06	1.04	.347
4,000, .....	.15	.83	.08	1.06	.265
5,000, .....	.15	.83	.10	1.06	.216
6,000, .....	.15	.83	.12	1.10	.183
7,000, .....	.15	.83	.14	1.12	.160
8,000, .....	.15	.83	.16	1.14	.142
9,000, .....	.15	.83	.18	1.16	.129
10,000, .....	.15	.83	.20	1.18	.118
12,000, .....	.15	.83	.24	1.22	.102
15,000, .....	.15	.83	.30	1.28	.085

This table is based on the assumption of a large residence:

Assume customers cost per year, at,	\$1.75
Assume readiness to serve cost (½" meters) per year, at,	10.00
Assume pumpage cost per 1,000,000 gals., at,	20.00

The principle of the sliding scale is that it costs more to distribute water to many small consumers than to a few large ones. The lowest price for

water should rarely be less than one-half of the domestic rate. Sometimes the highest rate charged for the first water is unduly large in comparison with the lowest rate charged for the largest quantities. When this ratio is 10 to 1 the slide is altogether too great.

A flat rate can only be applied in connection with a proper service charge. With an adequate service charge, the reason for the sliding scale is greatly reduced and there is much to be said in favor of the flat rate.

The fair way of getting at what a minimum meter service charge should be is to take the sum of *Consumers Cost*, the *Readiness to Serve* and the *Cost of Furnishing the Water*, and of course, the whole thing is predicated upon the *Value of the Property or Water Works*.

The Supreme Court of the U. S. has said that for rate making purposes, the value to be arrived at is the Fair Present Value and in fixing that value consideration must be given to the ability of the utility to meet reasonable demands of its customers for the present and for the future. Hence, no rate established should be higher than the value of the service rendered to the consumer.

On the other hand, a rate schedule constructed on considerations other than the Cost of the Service not only discriminates between customers and is therefore unjust and inequitable, but any rate constructed in this manner effectually retards a proper extension and development of the utility's business.

It would seem that the same rate to all would tend to discourage the use of the service on a large scale of consumption and this retards development of the business. There are numerous instances where this fact has been demonstrated.

Water companies argue something after this fashion: Let us assume that certain consumers wish to use the service a greater number of hours per day. In this connection it is a significant fact in the water business that the consumers who use water in large quantities are the longer hour users. A longer hour user is better for the output of the company because it makes a steadier consumption and does not require so large an investment of capital which lies idle, as compared with those who use large consumptions in a very short time. When a uniform rate is designed that will produce a total revenue to cover the cost of the service, including operating expenses, taxes and depreciation and fair return, it can only be arrived at by a process of averaging costs; thus the smaller and more unprofitable consumer pays less and the larger and more profitable consumer pays more. To recommend such a policy and then to state that the water company will give lower rates to the large consumer, if so desired, is merely temporizing with the situation.

It is further represented by the water companies that the smaller consumer cannot be made to bear his full share of the cost. If these consumers were made to pay the full cost of the service to them, it might be greater than the value of the service to them and more than they would pay. It is therefore necessary to shift more the burden of the cost from the large numbers of smaller consumers to that smaller number of consumers who use the greater portion of the total consumption.

In this Chester City water rate problem, the company and the city have agreed on the sliding scale and the service rate. The ready to serve charge is called minimum meter charge. The figures which the company presented were for a $\frac{3}{4}$ " meter, \$7.90 on the basis of 5% on the bonds. On the basis of 7% on the cost of the works and 1% for depreciation, the service charge figures were \$12.40, so the company asked for a minimum meter rate of \$12.00 for this class of consumers.

The conference cut this in half.

The conference also agreed upon a sliding schedule of rates which in connection with the minimum, will clearly eliminate unjust and unreasonable discrimination, and put everybody on the same plan, so that the burden of carrying the utility is placed equitably and in just proportion on each class of consumers as far as possible at this time, unless the whole valuation question is gone into.

This adjustment of the rates by the conference provides that every consumer will pay the same price for the first and second thousand gallons and so on.

Assuming that cost of the service shall be the basis of all rate calculation and since there are differences in the cost of service as between various classes of consumers, this difference in costs should be taken into consideration. They have been so considered and the rate schedule proposed will lighten the burden of 98% of the total number of consumers. They will, however, pay materially less than the cost of service as figured by the company. The conference believes that this cost should be actually demonstrated in Chester during the metering of the entire service, hence its conclusions.

In granting concessions to the conference the New Chester Water Company took the position, that while these rates agreed to are not confiscatory, they are unjust to the company, and it is well known that the point of injustice is reached long before that of confiscation. The company, however, was willing to settle temporarily along the line agreed to and if the returns are not sufficient after the plant is metered, the company will ask the Public Service Commission to put the proper value upon the property and to make rates in accordance with a proper and reasonable return.

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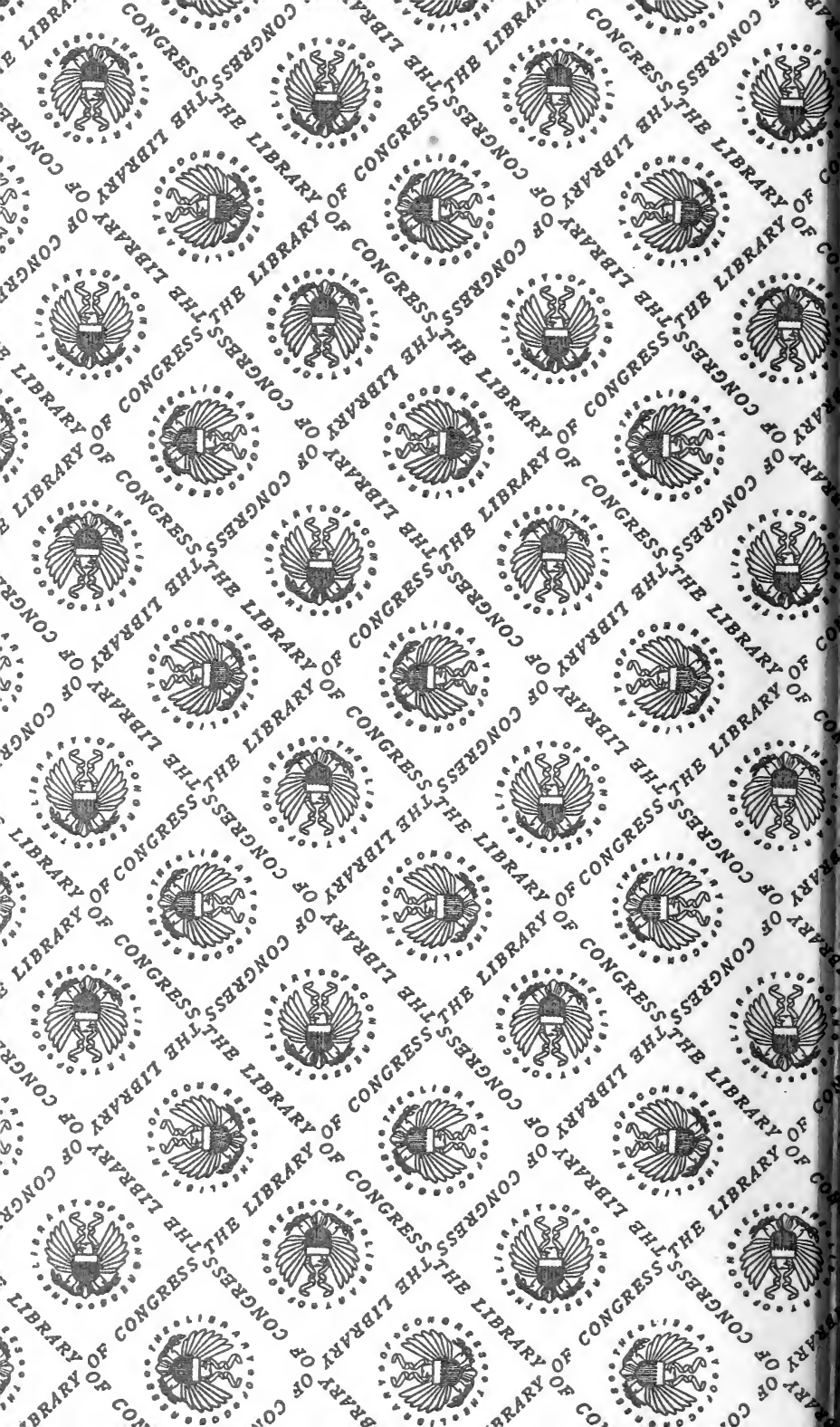


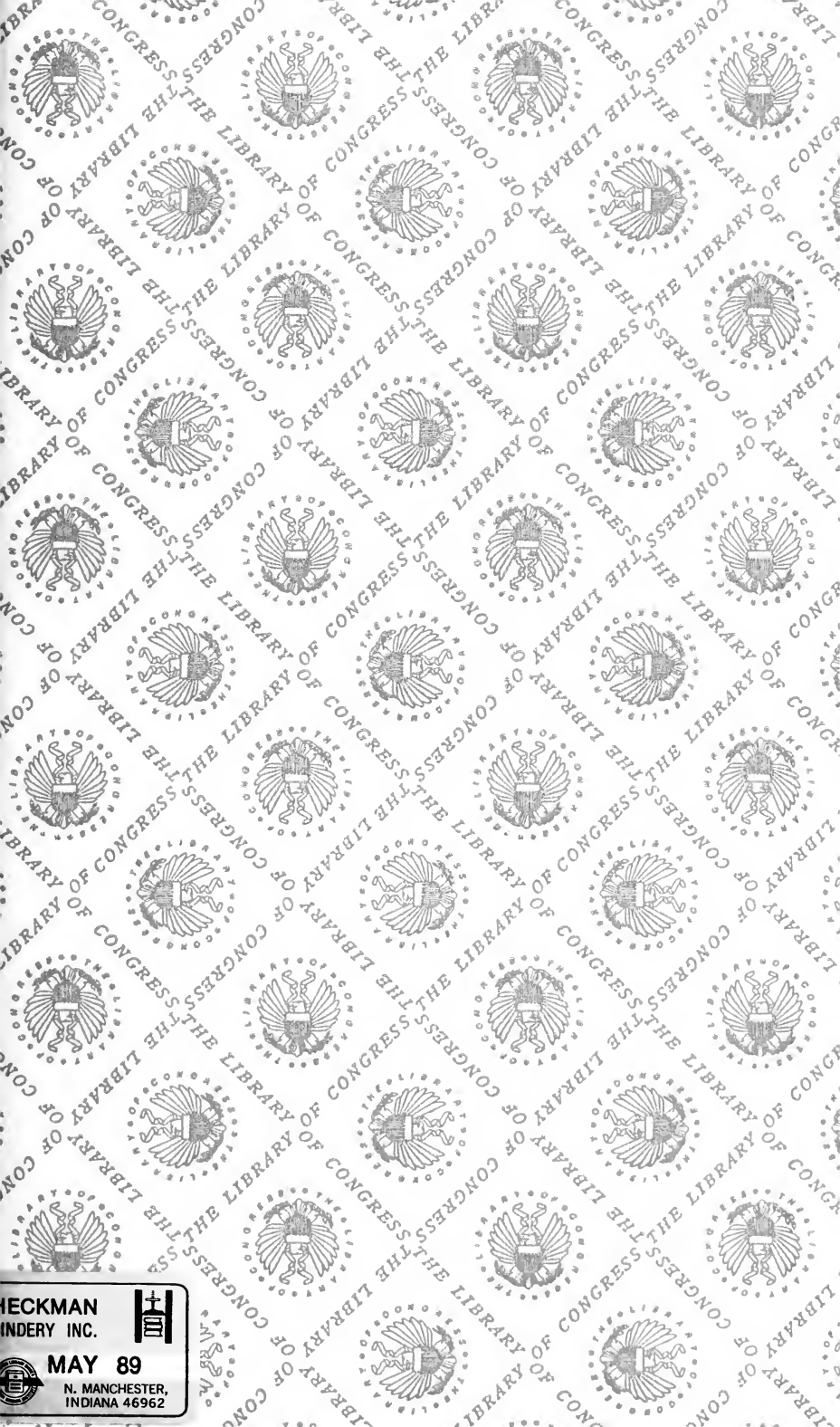


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